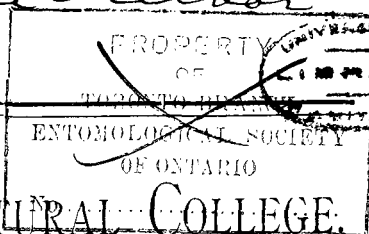


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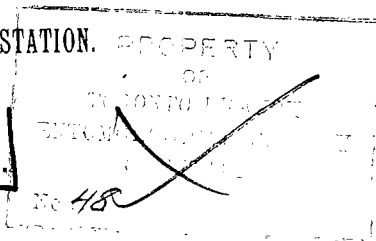
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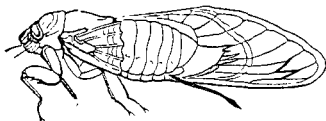
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Colorado's Worst Insect Pests And Their Remedies.



*Approved by the Station Council,
ALSTON ELLIS, President.*

FORT COLLINS, COLORADO.

JULY, 1898.

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Page 4, line 6, for 21 and 48. read 22 and 46.

Page 4, line 9, for 17A read 17.

Page 18, line 8, for *a, antenna* read *b, antenna*.

Page 18, line 12, for *Pratensis*, read *pratensis*.

Page 64, line 6 from bottom, for *Tetraoesp* read *Tetraopcs*.

Page 65, for 29B under upper figure, read 29A.

The cut on title page is a duplicate electrotpe obtained from the Div. of Entomology of the U. S. Dep. of Agriculture.

Colorado's Worst Insect Pests And Their Remedies.

BY CLARENCE P. GILLETTE.

INTRODUCTION.

It has been the object of the writer, in the preparation of the present bulletin, to put together, in condensed form, the largest possible amount of information that will be of practical value to the people of the state in combating insect pests. I have, therefore, avoided all technical expressions that might be annoying and meaningless to the general reader, and have only given the information that seemed to me necessary to enable one, who is not specially trained in entomology, to recognize the insect or its injury in each case and to know how to prepare and use the best remedies. There are a number of cases where the popular reader would say "worm," where I have said "larva," or "caterpillar," which are the more correct words; and I have used the words "pupa" or "chrysalis" for the resting stage of insects, but I take it that nearly all my readers know the meaning of these terms.

I have not attempted to make the present paper exhaustive, as that would be impossible in a bulletin of moderate size. I have only taken up those insects about which I am most often asked questions and concerning which I think information is most needed by the people.

It is hoped that all who are troubled with insect pests of any sort will feel free to make inquiries of the Experiment Station as to best methods of destroying them or preventing their injuries. Whenever possible, specimens of the insects or their work should accompany the inquiry.

ACKNOWLEDGEMENTS.

The figures that are not original in this bulletin, or that have not been used in previous bulletins of this station, have been obtained through the courtesies of Dr. L. O. Howard, Dr. J. B. Smith and Dr. C. M. Weed.

Figures 1, 4, 13, 14, 21, 30, 37, 41, 43 and 48 are duplicate electrotypes from Smith's "Economic Entomology" and were purchased from J. B. Lippincott & Co.

Figures 17A, 23 and 24 are duplicate electrotypes from "Insects and Insecticides"—Weed, and were purchased from Dr. Weed.

Credit for the other figures is given in each case, beneath the illustration.

APPLE-TREE ENEMIES.

THE CODLING MOTH. (*Carpocapsa pomonella* Linn.)

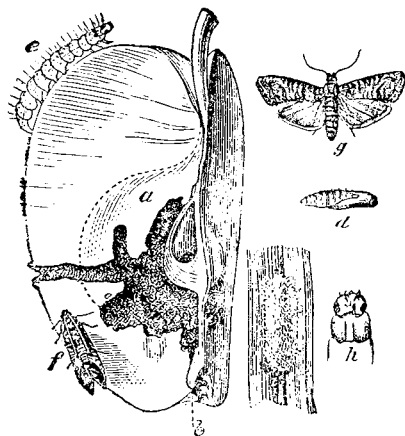


Fig. 1.—The Codling Moth: a, apple showing burrow; b, place where the worm entered; c, larva or worm; d, chrysalis or pupa; e, moth with wings closed; f, moth with wings spread; g, head end of larva; h, cocoon in which the larva changes to a chrysalis. All about life size except h. (After Riley).

A flesh-colored worm, eating into the fruit and making what are commonly called wormy apples. Common wherever apples have been grown for a series of years.

Remedies—About one week after the blossoms have fallen, make a thorough application of Paris green or London purple in a coarse spray in the proportion of 1 pound to 160 gallons of water. At the end of one week repeat the treatment, using the poison a little weaker (one pound to 200 gallons of water), unless heavy rains have intervened to

wash off the poison of the first application. The Kedzie arsenite of lime may be used in place of the above poisons if preferred.

In addition to one of the above mixtures use the following: Put burlap bandages on the trunks about June 15th and remove them every seven days to kill the larvæ and pupæ under them until the last of August. Then leave them until winter or *early* the next spring, when they should be again removed and the worms beneath them killed. The prompt destruction of fallen fruit will destroy some of the worms, but not a large proportion of them, probably about 15 per cent. Keep screens on windows and doors of cellars and fruit houses where apples are stored to prevent the moths that hatch in these places from flying to the orchard.

Scald in boiling water all boxes and barrels that have recently contained apples, pears or quinces.

THE APPLE FLEA-BEETLE. (*Haltica ignita* Ill.)

A small metallic-green beetle, about one-eighth of an inch in length, that eats holes in the leaves and jumps or takes wing quickly when disturbed.

Remedies.—Use London purple or Paris green in the proportion of one pound to 160 gallons of water; or use these poisons dry, diluted with flour. The Kedzie arsenite of lime, or arsenate of lead, would probably be equally efficient.

Dusting the foliage with lime, plaster, ashes, or tobacco dust, will usually drive the beetles from the trees, but these applications will not kill.

FRUIT-TREE LEAF-ROLLER (*Cacecia argyrosphila* Walk.)

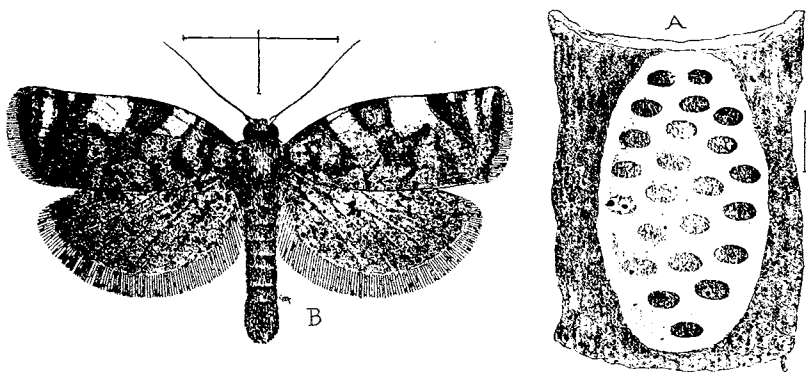


Fig. 2.—Fruit-tree Leaf-roller: A, egg-patch on bark from which the worms have escaped; B, moth. Both enlarged. The lines at the sides show the actual sizes.

Light green worms with black heads appearing upon the trees as soon as the leaves begin to open. The leaves are rolled or folded about the worms for the protection of the latter from their enemies. When abundant, both apples and foliage are sometimes entirely destroyed. The worms change to pupæ in the leaf rolls from which small yellow or rust colored moths appear in July. These moths deposit their eggs in oval patches on the trunk and branches of the trees where they remain dormant until the following spring.

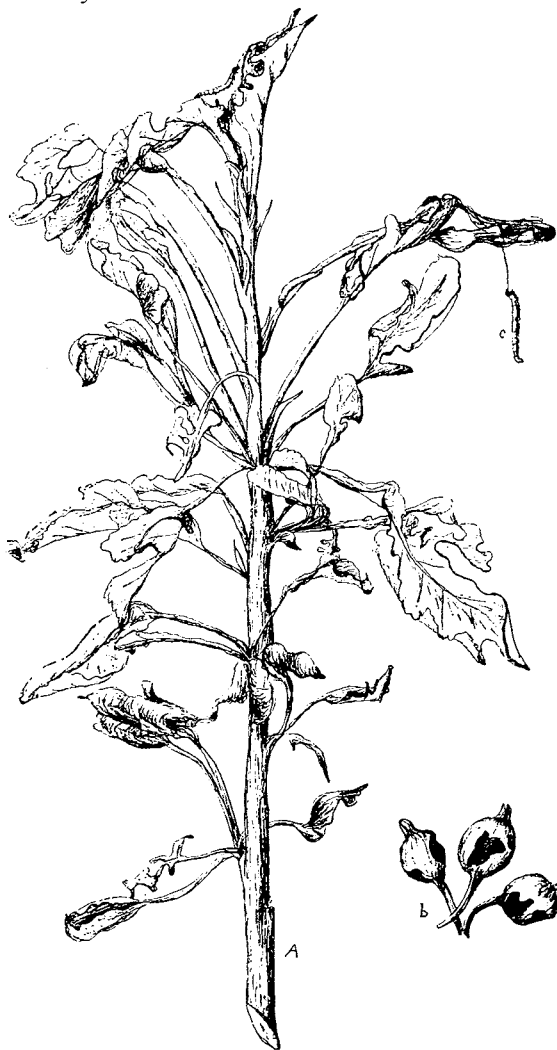


Fig. 3.—Fruit-tree Leaf roller: A, twig from apple-tree showing the rolled and eaten leaves; b, apples that have been eaten by the worms.

Remedies.—Crush as many of the egg patches as can be found during the winter or early spring when other work is not pressing. As soon as the blossoms have fallen spray with Paris green, London purple or arsenite of lime as for the Codling Moth. At the end of a week repeat the application. If heavy rains intervene, or if, for any reason, the worms are found to be continuing their work in large numbers after the end of another week, make a third application. Make the first treatment in the strength of about 1 pound of the poison to 160 gallons of water and the later ones a little weaker, about 1 pound to 200 or 240 gallons of water.

If the eggs are very abundant, it will be well to make one treatment just before the blossoms open.

The treatments made after the blossoms have fallen will also do service in destroying the Codling Moth and any leaf-devouring insects that may be present.

A thorough coating of white-wash upon the trunks and main limbs will destroy a large proportion of the worms while eating out from the eggs. My experiments have shown that the little worms cannot survive eating through a layer of lime over their egg patches. If the coating of lime does not cover the patches, or if it becomes loose and scales off before the worms eat their way out of the eggs, this treatment will do no good. The application of lime should be made about the middle of April, or just in advance of the blossoming of the earliest plum trees. Use the best quality of lump lime in making the wash.

Mr. David Brothers, of the Colorado State Board of Horticulture, reports great success in capturing the moths in pans of dilute cider vinegar set about the orchard at night. The moths begin to fly about the last days of June and continue for two or three weeks. This insect also occurs abundantly on many other trees, particularly, in this state, upon plum, cherry, pear, osage orange and currant and rose bushes.

THE TENT CATERPILLAR. (*Glisiocampa fragilis* Stretch.)

This insect is readily recognized by its white silken webs or tents in the crotches of the limbs of the trees early in the season. The tents begin to be formed as soon or a little before the leaves of apple trees begin to open. The caterpillars make their homes in the tents, but go out over the tree to feed. The tents are quite dense and seldom attain more than one foot in length. The caterpillars are all gone by the first of July.

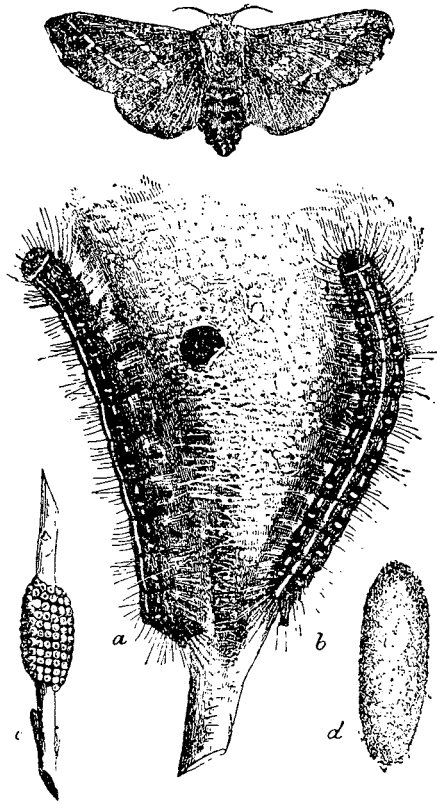


Fig. 4.—American Tent Caterpillar, (*Clisiocampa americana*): a and b, full grown worms on the outside of the tent; c, egg-mass with the gummy covering removed; d, cocoon containing the chrysalis; above all, the moth. (After Riley.)

Our western species (*Clisiocampa fragilis*) resembles the above so closely that the figure serves equally well for it.

Remedies.—Collect and burn the tents as soon as they are seen. This should be done early in the morning or in the evening when the worms are in the nests.

THE FALL WEB-WORM. (*Hyphantria cunea* Dru.)

A yellowish or brownish caterpillar with a black head that forms a large loose web or tent in a great variety of trees, beginning to appear about the first of July and continuing through the summer. The larvæ are rather sparsely covered with long hairs that are whitish or yellowish in color, with occasional black ones for variety. This insect is readily distinguished from the Tent Caterpillar in habits as the

larvæ of the Fall Web-Worm form a very loose tent with which they inclose the leaves upon which they feed, and they do not appear until the Tent Caterpillars have nearly or quite disappeared.

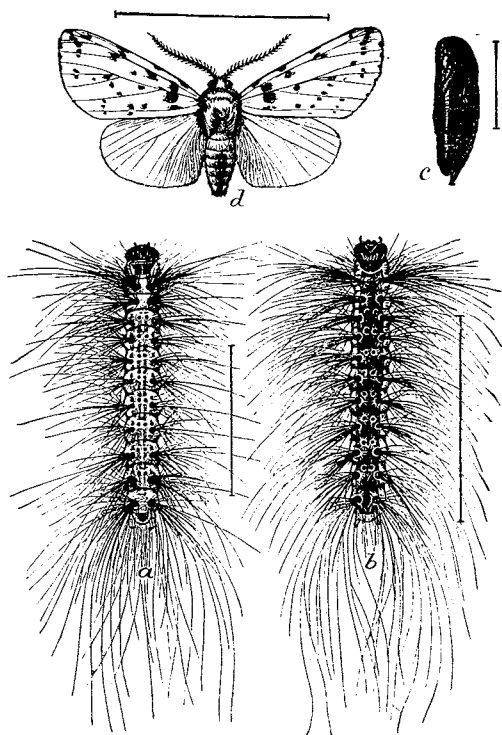


Fig. 5.—Fall Webworm: a and b, full grown larvae showing light and dark forms; c, the chrysalis; d, moth, showing dark spots. All some enlarged. The lines show the actual lengths. Usually the moths are entirely white. (Howard Yearbook, U. S. Dep. of Agr. 1895.)

Remedies.—If the webs are noticed when small they should be cut out and the larvæ destroyed. If the web has become large, enclosing many branches of the tree, it may be better to burn out the worms with a torch. Where there is no danger of poisoning fruit, Paris green may be sprayed or dusted upon the foliage immediately surrounding the web. These leaves will soon be enclosed for food and the worms eating them will die.

THE FLAT-HEADED APPLE-TREE BORER. (*Chrysobothris femorata* Fabr.)

A yellowish white larva boring beneath the bark in the

sapwood of apple and many other trees and quite peculiar in appearance on account of its having the anterior segments of its body (not its head) greatly enlarged and flattened.

Remedies—This borer is usually found on the south or southwest side of the tree where the bark has been scalded by the sun and it seldom attacks healthy, vigorous trees. So that the protection of the trunk from sun-scald and other injuries to the bark will do much to prevent the attacks of this insect.

If the borers get into the trees their presence is detected by the dark color of the bark, and in such cases there is probably no better remedy than to make a vigorous use of the pocket knife for their removal. This may be done in the fall or winter when work is least pressing.

The use of strong soapy mixtures and of kerosene emulsion during the month of June and the fore part of July are also much recommended, but the writer believes the pocket-knife remedy will prove most satisfactory.

THE APPLE-TWIG BORER. (*Amphicercus bicaudatus* Say.)

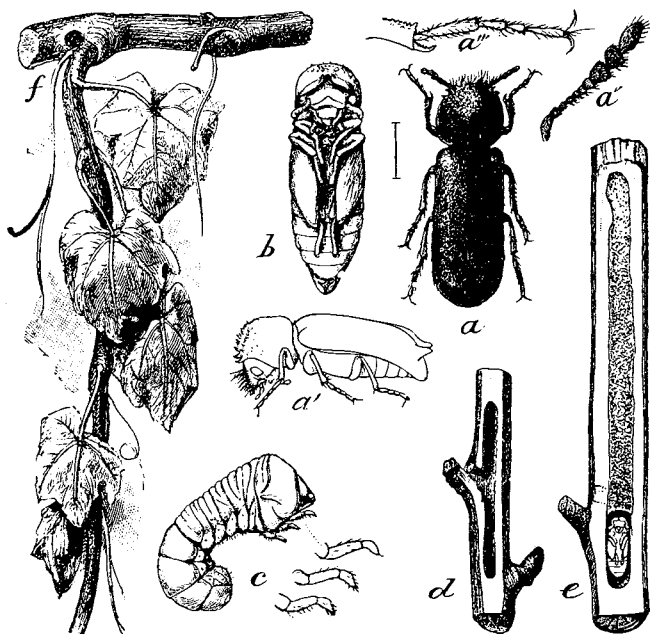


Fig. 6. Apple Twig Borer: a, beetle, dorsal view; a', beetle, side view; b, pupa from beneath; c, grub, side view; d, apple twig showing burrow; e, burrow in tamarisk with pupa at bottom; f, stem of grape showing burrow. All enlarged except the stems showing burrows. (Mariatt, Farmer's Bull, 70, Div. Entomology, U. S. Dep. of Agr.)

A cylindrical, mahogany-colored beetle, about one-third of an inch in length, boring holes in twigs of apple, pear, cherry, osage orange and other trees and grapevines, the burrow starting just above a bud and extending downwards.

Remedy—Cut out the infested stems and burn them.

THE BUFFALO TREE-HOPPER. (*Ceresa hubalus* Fabr.)

A light-green, three-cornered insect, about one-third of an inch in length. What appears to be the head, really the thorax, is large and broad and terminates abruptly, having on either side a short, sharp spine, or thorn, somewhat resembling the horn of the buffalo, and hence the common name of the insect, which is, withal, a good jumper. This insect feeds upon a great variety of plants and is quite abundant in Colorado. It does its chief injury while depositing eggs during the months of August and September in small limbs of various trees, including the apple. A double row of eggs is deposited in a longitudinal slit that the female makes in the bark. The growth of the limb spreads the slit into an oval scar as shown in the accompanying illustration.

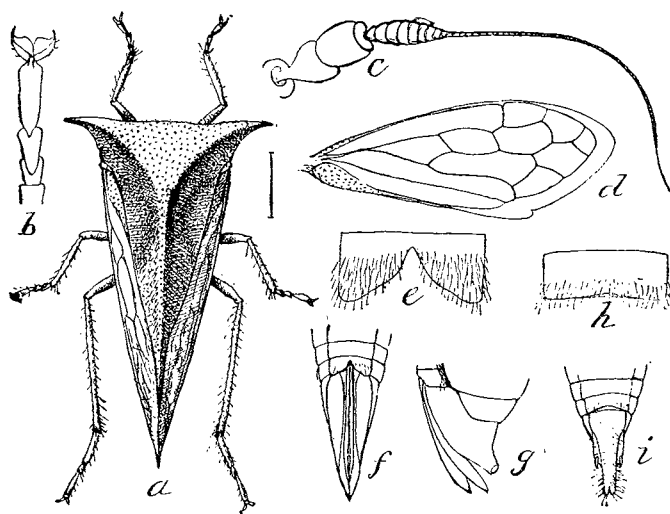


Fig. 7.—Buffalo Tree Hopper : a, female much enlarged; b, foot of same enlarged; c, antenna or feeler; d, wing; f and g, last segments of the female abdomen; i, last ventral segments of the male. (Marlatt, Circular 23, U. S. Dep. of Agr., Div. of Entomology.)

Remedy—These hoppers seem to have the habit of ac-

cumulating on certain small trees to deposit their eggs, so that some trees will be almost covered with scars, while others near by have few of them. About the only remedy seems to be to cut out the limbs in which the eggs have been deposited before the eggs hatch in the spring and burn them.

I have noticed these badly infested trees, as a rule, about the borders of the orchard or in orchards where a large amount of foul stuff was growing, and I believe clean culture will do much to keep this pest out of the orchards.

THE SCURVY BARK LOUSE. (*Chionaspis furfurus* Fitch.)

The presence of this insect is indicated by very small white scales upon the trunks or limbs of the trees, when abundant, entirely covering the bark and appearing like a covering of scurf or dandruff, and hence the common name. The female scales are broad and oval at one end and are about a tenth of an inch long; the male scales are not over one-twenty-fifth of an inch in length and are long and narrow.

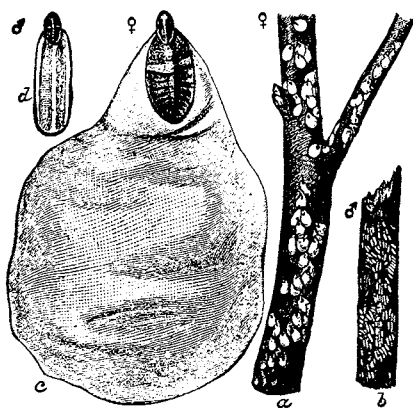


Fig 8.—Scurvy Bark Louse: a. twig showing scales of female louse; b, twig showing scales of male louse; c, scale of female greatly enlarged; d, scale of male greatly enlarged. (Howard, Yearbook, U. S. Dep. of Agr., 1894.)

Remedies—Whale-oil soap, 2 pounds to a gallon of water, kerosene emulsion that is one-fourth kerosene, or lime, sulphur and salt mixture, applied while the trees are dormant, would probably kill the scales. After the leaves are out, if the lice have not been killed, use kerosene emulsion of ordinary strength about the last of May and again about the 10th of June.

THE OYSTER-SHELL BARK-LOUSE. (*Mytilaspis pomorum*
Bousche.)

This scale is common in the eastern and northeastern U. S. and in Canada. It is an enemy of the apple-tree of considerable importance and will doubtless be found in some of the orchards of this State at no distant date, though it has not yet been reported in Colorado. It is a very easy pest to overlook. The scales are about one-eighth of an inch in length, a little curved like an oyster shell, and the color is almost exactly that of the bark of an apple tree. They occur chiefly upon the bark and, when abundant, weaken the vigor of the tree or even cause it to die. The scales are very well shown in Fig. 9. During the fall, winter and early spring, these scales have eggs beneath them. About the last of May the eggs hatch and the minute yellowish lice travel about over the tree, find suitable locations, insert their beaks, feed and grow, forming over themselves the peculiar scale under which they deposit eggs and die by the last of August or early in September.

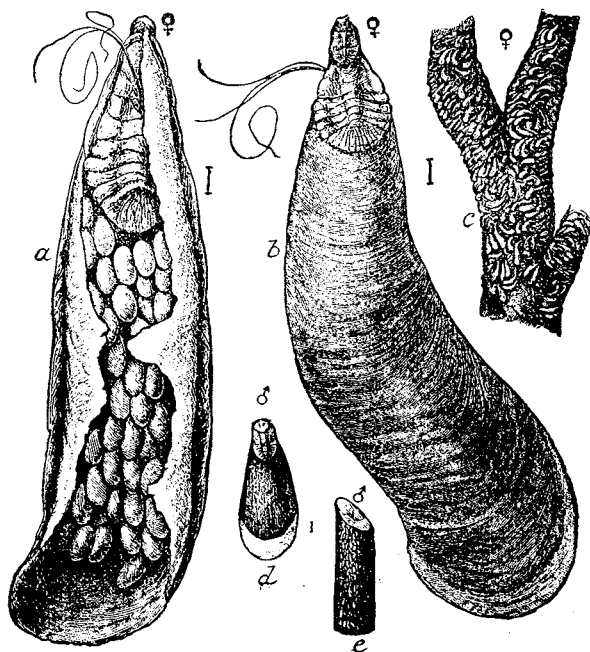


Fig. 9.—Oyster-shell Bark-Louse : a, female scale from below, showing eggs, greatly enlarged; b, the same from above; c, female scales on twig natural size; d, male scales, natural size; e, male scale enlarged. (Howard, Yearbook, U. S. Dep. of Agr., 1894.)

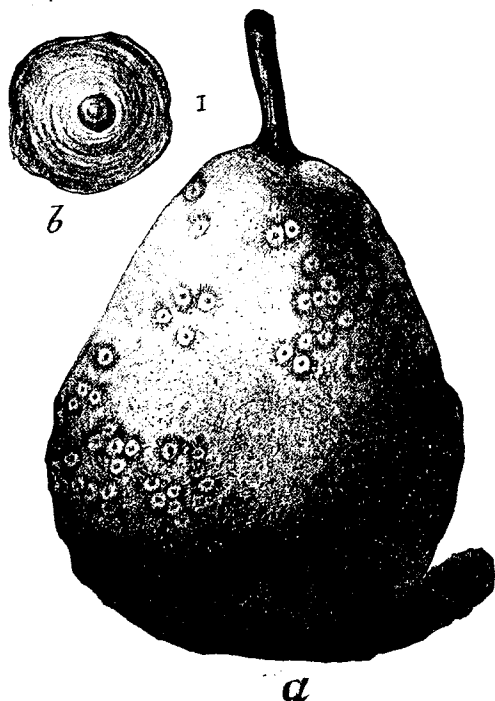
Remedies—The same as for the preceding species.

THE SAN JOSE SCALE. (*Aspidiotus perniciosus* Comstock.)

This is the most dreaded of the insect pests of the apple orchard. As yet there has been no authentic record of its occurrence in any of the orchards of this State, but it has been a most destructive orchard pest in California, Oregon, Washington, and in several of the eastern and southern states. It is transported from place to place almost entirely upon nursery stock and the utmost care should be exercised to prevent its gaining an entrance into any of the orchards of Colorado. It will feed upon almost any of the deciduous trees and shrubs and consequently is very hard to exterminate in any locality where it has once gained an entrance.

The scales are very inconspicuous so that trees are liable to be killed by the insects before the owner becomes aware of the presence of the scale.

The female scales are circular in shape and dark gray in color with a small red or rust-colored spot at the center and measure from one-sixteenth to one-twelfth of an inch across. The male scales are black in color and are smaller than those of the female. They occur upon trunk, limbs, leaves or fruit, and usually cause a reddish coloration of the tissue immediately about the scales, which is very characteristic of this species.



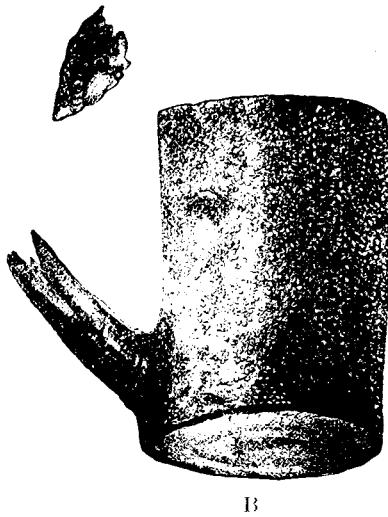


Fig. 10.—San Jose Scale : a, pear showing the scales, natural size; b, female scale enlarged; B, section of limb showing scales natural size. (Howard, Yearbook, U. S. Dep. of Agr., 1894.)

Remedies—While the trees are dormant use the same remedies as are recommended for the Scurvy Bark-Louse. In case it becomes necessary to treat the lice after the leaves are out, use kerosene emulsion or whale-oil soap of the ordinary strengths and make five or six applications at intervals of about five days. If an orchard, or even isolated trees, become badly infested and the lice do not succumb to winter treatment, it will usually be better to cut down the trees and burn them completely.

PUTNAM'S SCALE. (*Aspidiotus ancyclus* Putnam.)

This scale resembles the preceding so closely that it is impossible to give characters that will enable one who does not possess a compound microscope to distinguish between them with much certainty. The small male scales of this species are not black, however, as in case of the San Jose scale. When either of these scales are suspected it will be well to send specimens to the experiment station for determination.

Remedies for this species are the same as for the Scurvy Bark-Louse mentioned above.

THE APPLE PLANT-LOUSE. (*Aphis mali* Fabr.)

During the winter and early spring there are small shining black specks in rough places in the bark and about the buds, or, as is often the case when abundant, distributed promiscuously over the surface of small limbs, usually most abundant where there is abundance of fine plant hairs making a felty covering to which the eggs are easily attached. See Fig. 12.

Just before the buds open, the eggs hatch, producing a green louse which grows to about one-twelfth of an inch in length and which takes up its abode upon the leaves where it grows rapidly and, by its injuries, causes the leaves to curl so as to form for itself a partial protection.

Remedies—The best time for treatment is while the trees are dormant, any time after the leaves fall and before the buds open. For treatment during this time use either kerosene emulsion, double strength (diluting only enough to make the mixture one-seventh kerosene), or whale-oil soap in the proportion of 1 pound to six gallons of water. The very best time to make the application is after the lice have all hatched and just before the buds open enough to give the lice protection. The danger in waiting for this time is that one is liable to wait a day or two too long and then the lice will get into the open buds and be so protected that some will escape to perpetuate the species and the increase is very rapid.

After the leaves are out, kerosene emulsion of the ordinary strength (one-fifteenth kerosene), or whale-oil soap in the proportion of 1 pound to 8 gallons of water, are the best remedies. Apply as a spray and be sure to make the application thorough.

THE WOOLLY APHIS. (*Schizoneura lanigera* Hausm.)

A very soft-bodied louse, more or less covered with a white, flocculent excretion, resembling wool, and causing a blood-brown stain when crushed in the hand. One form of this insect occurs on the roots of the trees and produces wart-like swellings; another appears on the trunk and limbs and is usually densely covered with the woolly excretion.

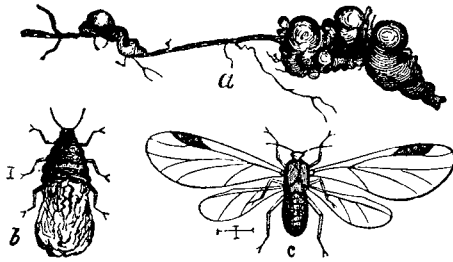


Fig. 13.—Woolly Aphis, root form : a, small root showing swellings caused by the lice; b, wingless louse showing woolly secretion; c, winged louse. The lice are very much enlarged, the actual sizes being shown by the lines at the sides of the illustrations.

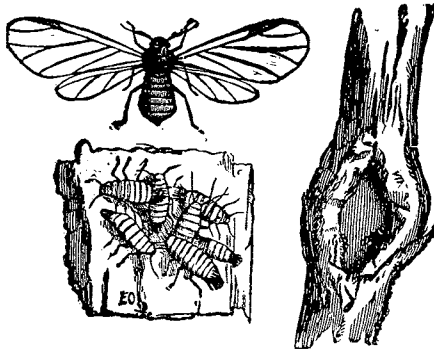


Fig. 14.—Woolly Aphis, aerial form, showing winged and wingless lice enlarged, and a scar on a limb that has been attacked by the lice.

Remedies—Probably the best remedy for the root form is tobacco dust worked into the ground to the amount of 3 to 6 pounds about the crown of the tree and then wet with water.

In the hands of one who has had experience, carbon bisulphide may be used effectually by injecting it into the ground about the crown of the tree. Kerosene emulsion, whale-oil soap and hot water, have all been used successfully, but probably all should give way to tobacco dust, which is cheap, effectual and lasting in its effects.

To keep the aerial form in check, begin in the latter part of May when the little white patches of lice begin to appear about wounds and tender places on the bark of the tree and, by means of a paint brush, apply pure kerosene to every patch of lice that can be found.

If the lice spread over the tops of the trees they may be treated with kerosene emulsion, ordinary strength, but it is necessary to throw it with a great deal of force so as to wet through the "wool" which protects the lice from any light spray.

Where the lice are found on the roots of nursery stock, it is advisable to dip the roots in ordinary kerosene emulsion, or in whale-oil soap in the proportion of 1 pound to 8 gallons of water or to fumigate with hydrocyanic acid gas.

Other insects mentioned in this paper that sometimes occur on the apple, are Red Spider, the Brown Mite and Grasshoppers.

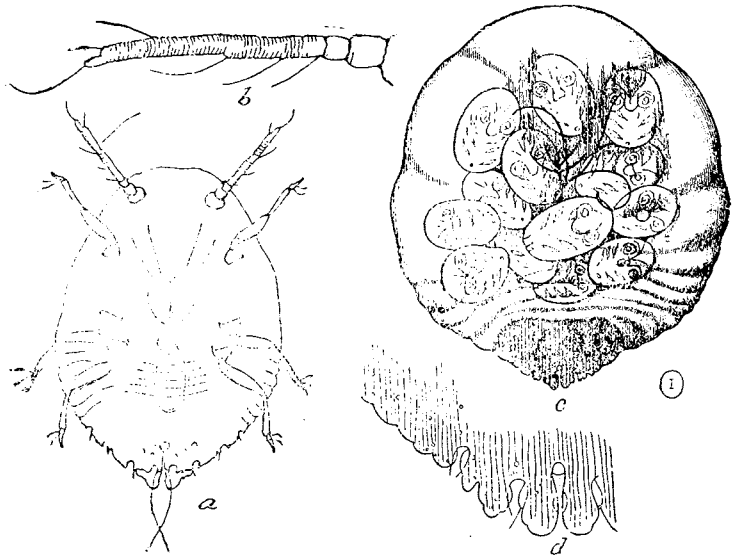


Fig. 11.—San Jose Scale: a, female removed from scale; a, antenna; c, gravid female showing unborn young; d, tail end of a female, all greatly enlarged. (See page 14)

PEAR-TREE ENEMIES.

THE BROWN MITE. (*Bryobia Pratorensis*, Garman.)

This insect is also called "Clover Mite," and in some localities it is called "Red Spider" on account of the rust-red color, but the last name is applied to another mite treated on another page. The eggs of this insect, are nearly globular, of a bright red color, and often occur in enormous numbers on the bark of pear, apple and other orchard trees, most often on the pear in Colorado. They give the bark a rusty red appearance and will stain the hand if it is rubbed over them. The eggs are so small that, without a glass, it would be impossible to discover their real nature. During May they hatch and the little mites coming from them are,

at first, a bright vermilion red in color. As they grow this color fades into a rusty brown. When mature, the mite resembles a very small spider and is just large enough to be plainly seen by one who has fairly good eye-sight.

As the result of the attacks of this mite the foliage of the tree becomes bleached and sickly in appearance. Aside from the pear it attacks badly the cherry, apple and plum and perhaps a few other trees.

Remedies—Those who use the lime, sulphur and salt wash in the vicinity of Grand Junction, Colo., assure me that it completely rids their trees of Brown Mite.

In my own experiments I have found whale-oil soap in the proportion of one pound to 4 gallons of water, or kerosene emulsion diluted so that the kerosene will be one-eighth of the mixture, applied before the eggs hatch, to destroy the latter completely, none whatever hatching where thousands were treated. The same applications in one-half the foregoing strengths will kill the mites after they hatch. The best time to make the treatment is before the eggs hatch.

THE PEAR-TREE SLUG. (*Eriocampa cerasi* Peck.)

This insect attracts attention as slimy, olive-green slugs upon the leaves, which they kill by eating off the soft part and leaving the veins. When abundant, they entirely destroy the foliage, leaving the leaves brown and dry as if killed by fire. There are two broods, one appearing in June and one in August.

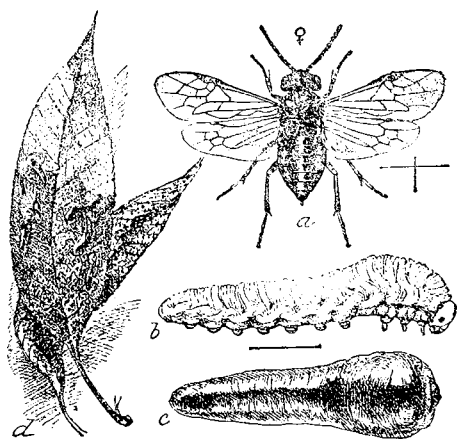


Fig. 15.—Pear Slug: a, adult female fly; b, larva or slug with the slimy covering removed; c, same as the preceding in natural condition; d, leaves showing slugs and their injuries. (Marlatt, Circular 26, Second Series, U. S. Dep. of Agr., Div. of Entomology.)

Remedies—There are several remedies that may be successfully used against this insect. White hellebore lightly dusted over the foliage in the evening, or applied in a watery spray in the proportion of an ounce to three gallons, is probably the best. Paris green or London purple dusted or sprayed upon the foliage will accomplish the same result. Air-slaked lime or strong wood ashes have often been recommended and are probably of some use. Even fine road dust has been recommended as all sufficient for the destruction of the slimy larvæ of this saw-fly, but I am inclined to think that the last of these remedies, at least, is of little use, and I have dusted lime freely upon the slugs without any apparent harm to them. Pyrethrum, or Persian Insect Powder, dusted over the slugs will kill all that it comes in contact with.

This slug also attacks the foliage of plum and cherry trees.

THE PEAR LEAF-BLISTER. (*Phytoptus pyri* Scheuten.)

This disease is indicated by small black spots appearing upon pear leaves, sometimes so numerous as to run together and involve a great portion of the leaf. Before turning black the spots are green like the rest of the leaf. An examination of the spots will show that they are slightly thickened portions and each one is the habitation of a large number of very minute parasites.

Remedies—The parasites spend the winter, chiefly, under bud-scales upon the trees, and may be killed during winter or early spring, when the trees are dormant, by a spray of kerosene emulsion in which the kerosene is one-fifth of the mixture.

Other insects mentioned in this paper that are sometimes found attacking the pear, are: Codling Moth, Red Spider, Brown Mite, Fruit-tree Leaf-roller, Tent Caterpillar, Flat-headed Borer, Fall Webworm, Buffalo Tree-Hopper, San Jose Scale and Putnam's Scale.

PLUM-TREE ENEMIES.

THE PLUM GOUGER. (*Coccotorus prunicida* Walsh.)

This insect is often mistaken for the Plum Curculio, mentioned below, which does not occur in Colorado as yet. The Gouger is a native of the Western United States, where it has fed from time immemorial upon native plums and it

has not yet acquired a taste for the more luscious European varieties. At least, it seldom attacks anything but native varieties of the plum.

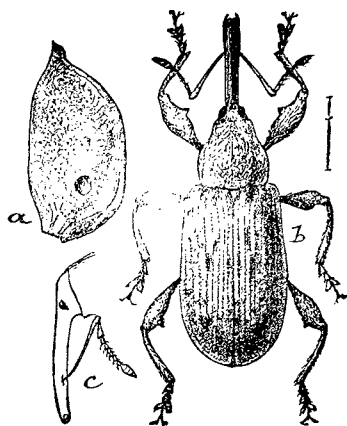


Fig. 16.—Plum Gouger: a, plum pit showing hole for exit of Gouger; b, Gouger. (Riley & Howard, *Insect Life*, Vol. II. U. S. Dep. of Agr., Div. of Entomology.)

The beetle is about one-fourth inch in length, has a rather long, curved snout, or rostrum; the wing covers are of a leaden gray color, finely spotted with black and brown, while the thorax and head are ochereous yellow. The beetles begin appearing before the blossoms open. At first they puncture the calyx and feed on the ovary of the flower, completely destroying it for the production of fruit. Later their punctures may be seen on the growing plums, some being made for food and others for the purpose of depositing eggs. In the laboratory six of the beetles, in 24 hours, punctured the calyces and ate the ovaries of 65 buds and blossoms. The punctures made for egg-laying are shallow and the egg, after being deposited, is flush with the surface

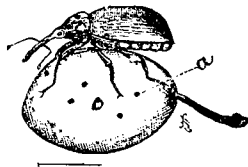


Fig. 17.—Plum Gouger and its punctures on a plum. (After Bruner.)

of the plum. For a short time it is yellowish white in color, but, where it is exposed to the light, it soon becomes shining jet black. The larvæ on hatching eat their way directly to

the pit leaving a minute black line to mark their course. On reaching the pit they do not burrow about it as in the case of the Plum Curculio but burrow straight on into the meat of the pit on which they feed until fully grown. Then the grub eats a hole through the pit so it can escape after it has changed to a beetle. The beetles emerge usually a little before the plums ripen, and destroy the fruit. The fruit that is punctured by the beetles becomes hard and gnarly and is usually worthless.

Remedies—My experiments do not indicate that poisonous sprays can be used to any profit against this insect. The best remedy we know of at present is to jar the trees daily, either in the morning or in the evening and catch the beetles on sheets spread beneath the trees. Make a large sheet for the purpose, slit it from the middle of one side to the center and, in using, pass the strips thus made either side of the tree so that the latter will stand at the center of the sheet. Two men can use such a sheet very rapidly. Begin the work as soon as the trees blossom and continue as long as you can get half as many gougers as the number of trees jarred.

THE PLUM CURCULIO (*Conotrachelus nenuphar* Herbst.)

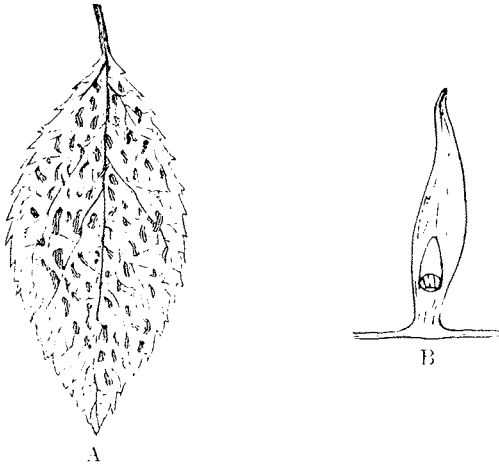
This is by far the most serious pest to plum culture in the East. It also attacks other pit fruits, including the cherry. A dark brown to blackish snout beetle, about one-fifth of an inch long and with four prominent humps on each wing cover. The mark that the beetle makes on the fruit when "stinging" it for the deposition of an egg is very characteristic and has given this insect the appellation, "Little Turk." A puncture is made with the jaws and an egg deposited in it and then the beetle turns about and cuts a crescent partly surrounding the egg. The grub eats through the flesh of the plum to the pit and then feeds about the pit but never eats into it. The fruit, as the result of this injury, falls.

Remedies—Jarring as for the Plum Gouger is the best remedy for this insect. Some benefit can be derived from the use of arsenical sprays but, if the same expense is put into the work of jarring and collecting the beetles, it is generally believed that more good will be derived.

Where chickens can be kept in large numbers under the trees early in the season this insect seldom does much injury.

THE PLUM-LEAF NAIL-GALL (*Phytoptus* sp.)

The leaves of the American varieties of the plum are sometimes injured by the production of a large number of slender tubular projections standing out from their upper surfaces as shown in the accompanying illustration. Inside each gall is a large number of very small spider-like insects or mites of the appearance of Fig. 19.



Figs. 18 and 19.—A, plum leaf showing the galls; B, one of the galls enlarged and cut to show the interior.

Remedies—Probably nothing can be done of much value while the leaves are on the trees. Fallen leaves should be destroyed as far as possible by fire and the trees should be sprayed during the winter or early spring with

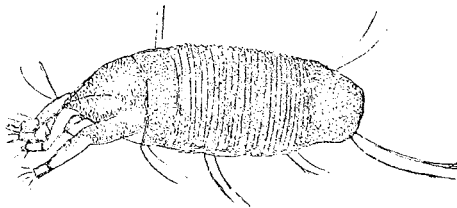


Fig. 20. One of the mites that produce the nail-galls on plum leaves greatly enlarged.

kerosene emulsion of double strength (an emulsion in which the kerosene is about one-seventh of all), or whale-oil soap in the proportion of 1 pound to 4 gallons of water.

PLANT LICE.

For all plant lice attacking the plum, use the remedies recommended for the Apple Aphis. Apply the mixtures with considerable force so as to thoroughly wet the bodies of the lice.

The following insects, treated in this bulletin, also attack the plum: The Pear Slug, Tent Caterpillar, Fall Webworm, Red Spider, Brown Mite, Peach Borer, Grape Leaf-hopper, San Jose Scale and Putnam's Scale.

PEACH-TREE ENEMIES.

THE PEACH BORER (*Sannina ovifera* Say.)

A yellowish white larva, or borer, working beneath the bark at the crown of the tree and down on the roots causing the exudation of a gummy substance. The eggs are laid about the crown of the tree by a small moth with narrow steel-blue wings that flies in the bright sunshine and much resembles a wasp in appearance.

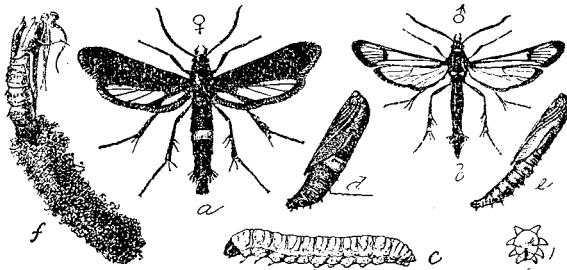


Fig. 21.—Peach tree Borer: a. adult female; b. adult male; c. full-grown larva; d. female pupa; e. male pupa; f. pupa skin and cocoon. All about natural size. (Mariatt. Circular 17. Second Series. U. S. Dep. of Agr. Div. of Entomology.)

Remedies—Wherever the gummy exudation is seen, cut out the borer with a knife. This should be done early every spring, without fail, and if thoroughly attended to, will keep the insect in check. A little dirt should be brushed away from the the crown of the tree to discover any burrows that may not be apparent at the surface. Many preventives have been recommended to keep the female moth from depositing her eggs upon the trees. Wrapping the trunks of the trees to a height of 8 or 10 inches with tarred paper is probably as good as any of these.

Any of the following insects mentioned in this bulletin may also be found attacking the peach: Plum Curculio, San Jose Scale, Red Spider, Brown Mite and Plant Lice.

CHERRY-TREE ENEMIES.

The insects mentioned in this paper that may also be found attacking the cherry are : the Fruit-tree Leaf-roller, Tent Caterpillar, Fall Webworm, San Jose Scale, Brown Mite, Pear Slug and Plum Curculio.

THE ACHEMON SPHINX. (*Philampelus achemon* Drury.)

The young larva has a long horn on the last segment of the body while the fully grown worm only has a shining black spot. The eggs are deposited early in July on the leaves of grape and Virginia creeper. The larvæ soon hatch from them and feed on the leaves until about the last of August when they become fully grown and descend to the ground to pass the winter in the chrysalis.

Remedies—The worms are so large that they are readily seen and can be collected by hand and destroyed. They may also be destroyed by the use of Paris green or London purple sprayed or dusted on the leaves or, when unsafe to apply poison, by the use of Pyrethrum.

INSECT ENEMIES OF VIRGINIA CREEPER.

The foregoing enemies of the grapevine also attack the Virginia creeper and the remedies to use are the same in both cases.

INSECT ENEMIES OF SMALL FRUITS.

THE EIGHT-SPOTTED FORESTER (*Ulypia octomaculata* Fab.)

The larvæ of this insect are common upon the grape vines in July and again in September. They are marked with numerous white, black and reddish cross-lines. On the middle segments of the body there are about eight black and seven white cross-lines to a segment and a broader reddish line on the middle of the segment. Low on the sides of the body and back of the three anterior pairs of legs there are rather irregular white blotches. When fully grown the larvæ are about one and one-half inches long.

The moth spans a little more than an inch from tip to tip of wings, and is black in color with two large cream colored spots on each fore wing and one large and one small white spot on either hind wing, the large spot being at the

base of the wing. The moths fly in May and again in the early part of August.

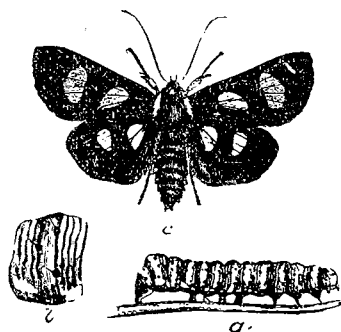


Fig. 22.—Eight-spotted Forester: a. larva; b. one segment of body of larva enlarged; c. moth. Natural size except b.

Remedies—When safe to use poisons, spray thoroughly with Paris green or London purple. If there is fruit nearly grown so as to make the application of poison unsafe, use a bellows duster and make a thorough application of Buhach (*Pyrethrum*.)

This insect also attacks Virginia creeper badly.

THE GRAPE LEAF-HOPPER. (*Typhlocyba comens* Say.)

A very small jumping insect about one-eighth of an inch long and light yellow in color beautifully marked with red and black. When abundant, these hoppers will fly from the vines in large numbers when the latter are jarred. They cause the leaves to turn pale and sometimes they will even turn brown and curl up. In early spring, before the grape leaves open, these insects sometimes occur in enormous numbers on strawberries and I have also seen them in considerable numbers on currant and gooseberry bushes and upon Virginia creeper.

Remedies—Spray forcibly with kerosene emulsion early in the morning, before sunrise. At this time the hoppers are dumpish and can be easily knocked off the leaves with the spray and wet down with it.

When abundant on strawberries early in the spring it is very important to make a thorough treatment of the emulsion as above, or, if the vines have not started too much, spread a light covering of straw over the patch and burn it.

THE IMPORTED CURRANT BORER. (*Sesia tipuliformis*, Linn.)

Piths of currant stems burrowed out by a yellowish white larva about half an inch long. Before maturing the larva eats a hole to the outside. Bored stems sometimes wilting and dying and sometimes breaking down as the result of the injury.

Remedy—Cut out the infested stems and burn them before the first of June each year.

THE NATIVE CURRANT SAW-FLY. (*Pristiphora grossulariae* Walsh.)

A green larva, about half of an inch long when fully grown, feeding upon the leaves of currant and gooseberry bushes. Appearing late in June and again about the last of August. The adult insect is a black four-winged fly about the size of a house-fly. The eggs are deposited, one in a place, under the epidermis of the leaves.

Remedies.—The best remedy for this pest is white hellebore dusted lightly over the foliage in the evening. If this is carefully done, nearly every larva can be found dead under the bushes the next morning. Paris green or London purple may be used either dry or in water as for other leaf-eating insects. The latter poisons should not be used before the currants are picked.

THE WESTERN CURRANT AND GOOSEBERRY SPAN-WORMS. (*Thaumnonoma*, sp.)

Light yellow larvæ, about one inch long when mature, and looping their bodies when walking. Sometimes completely stripping the foliage from the bushes.

Remedies.—Dust or spray Paris green or London purple as for other leaf-eating insects, or dust freely with Buhach (Pyrethrum). A thorough spraying with kerosene emulsion would probably be equally effectual.

Other insects mentioned in this paper that attack currants and gooseberries are: Red Spider, Tent Caterpillar, Fruit-tree Leaf-roller, Grape Leaf-hopper and Grasshoppers.

STRAWBERRY LEAF-ROLLER. (*Phloxopteris fragariae*, W & R.)

Small yellowish-brown to greenish larvæ, attaining nearly one-half inch in length when fully grown, and having the

habit of folding the leaves of the strawberry vines for their protection. When abundant they almost completely defoliate the vines. There are two broods, one appearing late in June and another in August.

The mature insect is a small rust-colored moth with more or less white and black markings on the wings and spanning about half an inch from tip to tip of wings.

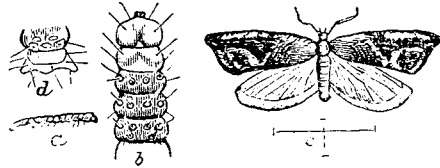


Fig. 23.—Strawberry Leaf roller: a, larva natural size; b, head end of larva enlarged; c, moth about twice natural size; d, tail end of larva enlarged. (After Riley).

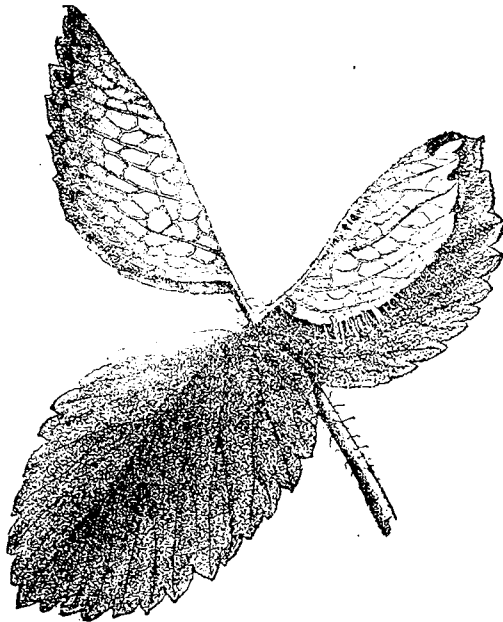


Fig. 24.—Strawberry leaves showing their appearance when folded by the roller. (After Wedd).

Remedies.—This is a rather difficult insect to manage as it is not safe to use the arsenites on the plants for the first brood. When the larvæ first appear, dusting the foliage lightly with white hellebore will destroy many of them. When the second brood appear, and the berries have been

picked, apply Paris green in flour dusting it thoroughly over the leaves in the evening when there is some dew on. An application very early in the morning will do equally well. Mix the poison and flour in the proportion of about 1 to 20 by weight and dust from a cheesecloth sack.

This insect has been reported quite abundant about Rocky Ford, this state, and it is the only place that I know it to occur in Colorado.

The other insects mentioned in this paper that attack the strawberry are: Red Spider, Apple Flea-Beetle and the Grape Leaf-hopper.

INSECT ENEMIES OF ROSE BUSHES.

THE RED SPIDER. (*Tetranychus*, sp.)

This insect is seldom abundant enough to do appreciable harm to orchard trees, but often becomes a serious pest on rose and currant bushes, sweet peas and other low plants. Although called "Red Spider," it is seldom red in color, but nearly always pale green with about three dark blotches on either side of the body. It is spider-like in appearance and is so small as to be seen with difficulty without the aid of a magnifying glass. It inhabits, chiefly, the under side of the leaves.

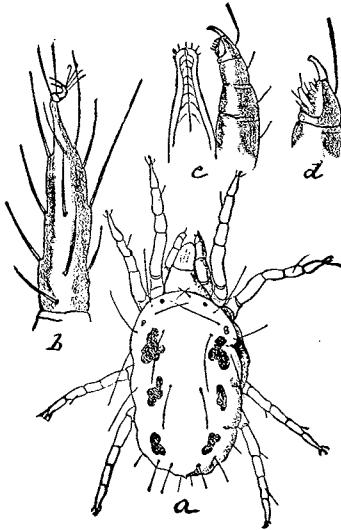


Fig. 25.—Red Spider : a, view from above, adult ; b, one of the feet showing claw ; c, the beak and one of the feelers or palpi ; d, the end of the palpus more enlarged. All greatly enlarged. (Riley, Insect Life, Vol. II, U. S. Dep. of Agr. Div. of Entomology.)

where it works beneath a very delicate web which it spins. In this respect it differs from the Brown Mite which does not spin a web. The eggs are deposited under the web and are globular and transparent.

Remedies.—This insect thrives best in a dry atmosphere and the free use of water is probably as good a remedy as has been found. Apply often in the form of a spray taking pains to treat the under side of the foliage.

In addition to the above, the Fruit-tree Leaf-roller and a Plant Louse also attack the rose. I have also been informed that the Rose Slug, an insect resembling the Pear Slug, has become a pest in Denver. The remedies for it are the same as for the Pear Slug.

SHADE-TREE ENEMIES.

THE BOX-ELDER LEAF-ROLLER. (*Cacoclia semiferrana*, Walk.)

This insect is a close relative of the Fruit-tree Leaf-roller and it is quite commonly thought not to be different. It seems to confine its attacks exclusively to the box-elder, however, in this state, as I have never yet found the larvæ feeding upon anything else. Its habits and appearance are much like the fruit tree species.

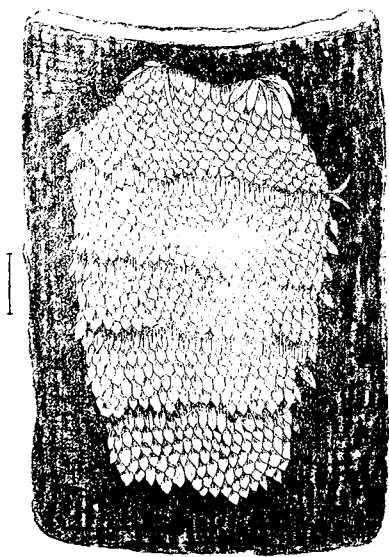


Fig. 26.—Egg-patch of Box-elder Leaf-roller, greatly enlarged to show the arrangement of the scales.

Fig. 27.—Two trees that were standing side by side, the one at the right untreated and the foliage all eaten off; the one at the left treated with Paris green and the foliage saved. From photograph by the author.



The moths are almost pure straw yellow, some with dusky markings above, and the abdomen of the female is largely black beneath. The eggs are laid in the crevices of rough bark and are covered with the scales from the underside of the abdomen of the female which are placed like

shingles upon a roof as shown in Fig. 26. The larvæ are light green or yellowish green in color and lack the black coloration of the head which is so distinct in case of the fruit tree species.

Remedies—The same as for the Fruit-tree Leaf-roller.

THE BOX-ELDER PLANT-BUG. (*Leptocoris trivittatus* Say.)

A rather flat bug, about half an inch in length, appearing black with narrow red margins to the thick portion of the wings and to the thorax, and with the body beneath the wings red. The adult bug lives over winter in protected places and often becomes very annoying in the fall and on warm days in the winter by crawling into dwellings. Often seen in large numbers on the south side of stone or brick walls in the sunshine and sometimes called "brick bug" in consequence. When warm weather in the spring comes on, the bugs go to box-elder trees and deposit their reddish eggs in crevices of the bark. The young feed chiefly on box-elder.

Remedies—Boiling hot water dashed upon the bugs when clustered upon buildings will destroy them. Ordinary

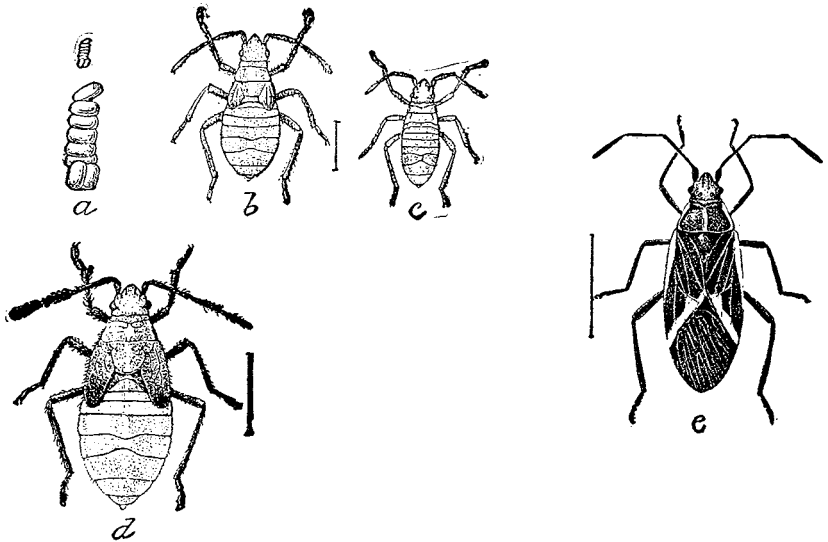


Fig. 28.—Box-elder Plant-Bug: a, eggs; b, c, d, different stages of the immature insect; e, mature insect. All considerably enlarged. [Howard, Circular 28, Second Series, U. S. Dep. of Agr., Div. of Entomology.]

applications for the destruction of these adult hibernating

bugs are useless. I have used kerosene emulsion, whale-oil soap, tobacco decoction, Zenoleum and Pyrethrum, all very strong, and with almost no effect except to make the bugs uncomfortable for a time. I do not know of any experiments having been tried upon the young but presume that kerosene emulsion or whale-oil soap of ordinary strengths will kill them if thoroughly applied.

The only other insect that troubles the box-elder badly in Colorado is the plant-louse (*Chaitophorus negundinis* Thos). Use the same remedies as for the Apple Aphis.

THE COTTONY MAPLE SCALE. (*Pulvinaria innumerabilis*, Rath.)

A yellowish or brownish oval scale on the twigs of soft maple. During the fall, winter and early spring the scales are quite flat, but, during May, the scales become convex and, finally, a mass of white cottony threads appear at one end, raising that end of the scale from the limb to an angle of about forty degrees or even more. In this cottony mass an enormous number of minute yellowish eggs are deposited, often as many as 2,000 to the single scale. It is at this time that the scales attract most attention on account of the cottony secretion.

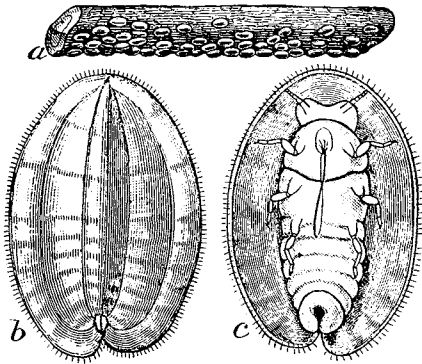


Fig. 29.—Cottony Maple Scale: a. eggs before hatching; b. egg after hatching; c. young larva; all much enlarged. (Riley, U. S. Dep. of Agr. Rep., 1884.)

Remedies—A thorough spraying with kerosene emulsion or whale-oil soap of ordinary strength will kill the young lice. If the application is delayed too long after hatching, the scales will so protect the lice that it will be

necessary to increase the strength of the mixture. If this is found necessary it will probably be better to treat as for the Scurvy Bark-Louse.

The soft maple is also attacked by the Fruit-tree Leaf-roller, Flat-headed Borer, Fall Webworm and Plant Lice.

THE ASH GALL-LOUSE. (*Pemphigus fraxinifolii* Thos.)

Greenish plant lice curling the leaves of white ash. The lice usually accumulate on the leaves at the end of a limb. The leaves curl and become so swollen and loaded with lice that the limb will often be bent down with the weight.

Remedy—As soon as the leaves at the end of the limb begin to curl, cut the limb off far enough back to include all the infested leaves and burn it.

THE COTTONWOOD BORER. (*Prionoxystus robiniae* Peck.)

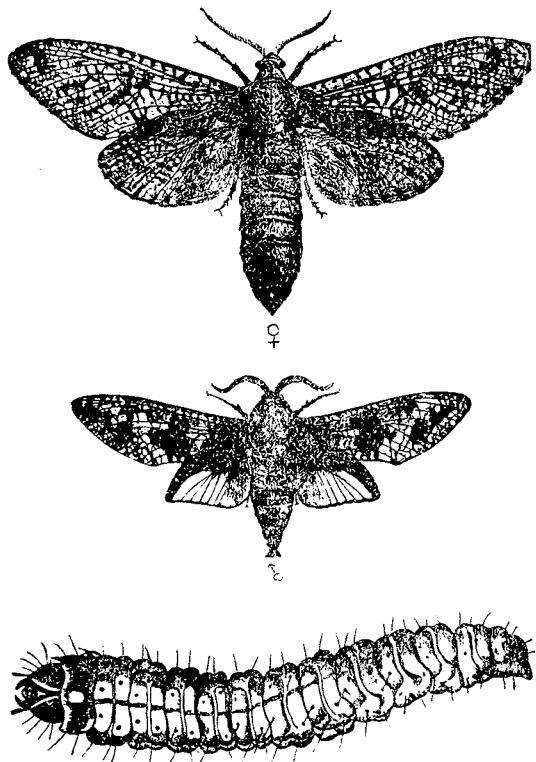


Fig. 30. Cottonwood Borer (*Prionoxystus robiniae*): Showing male and female moth and the larva. The female moth is the larger.

This insect is also known as the Oak Carpenter-Worm, but in Colorado it is known almost exclusively as a cottonwood borer. The larva, when fully grown, is nearly three inches in length, with a shining black head, and it cuts large holes in the trunks of the trees. Its work is most often noticed where a limb has been cut off or the trunk injured in some other way. The castings of the borers are pushed out on the surface and the tree bleeds as a result of the wounds made to the surface. The sap runs down on the trunk and sours, making a breeding place for maggots of certain flies. The moths have been taken at night at Fort Collins between June 14th and July 21. The females are larger than the males and both are well represented in the accompanying figure at about life size. The general color is gray, but the male has a large yellow spot covering the central portion of the hind wing on either side.

Remedies—It is hard to suggest a good remedy for this insect. Tacking a little wire gauze over the burrow before the middle of June would prevent the escape of the moth. Probably a wooden plug driven into the hole would serve the same purpose. With a stout wire one could kill many of the larvæ or pupæ in their burrows. Avoid scarring the trees as much as possible as the borers usually enter at such places.

The cottonwood is also attacked by Plant Lice, Fall Webworm and Putnam Scale, which have already been mentioned with their remedies. It is also attacked by a white scale (*Chionaspis orthobolis*), much resembling the scale figured on a following page on pine and spruce leaves. Remedies the same as for the other scales.

THE ELM LEAF-CLUSTER GALL. (*Schizoneura americana* Riley.)

The author's observations upon elms on the College grounds the present spring show that this louse appears on the trees before the leaf-buds begin to open, and that it attacks the base of a bud, soon becomes covered with a white flocculent secretion (see Fig. 32, e,) and that the bud, as it opens, curves downward so that the leaves hide the louse. The attack stimulates the opening of the bud and the growth of the leaves so that they are usually in advance of the other buds of the tree. By the middle of June, the infested leaves have formed a loose cluster, often as large as a man's fist or larger, within which is a disgusting mass of

lice and little globules of watery excretion that they have thrown off. Later the lice leave the galls, which become brown and dry, and go onto the leaves or tender bark about wounds on the tree. The leaves, as a result of the attack, become swollen and curled and usually take on a reddish coloration over the swollen portion.

Remedies—When the leaf clusters first appear, begin the work of cutting them off and destroying them. They occur mostly, on the small twigs near the trunk and on the lower branches of the tree. By going over the trees two or three times at intervals of about a week it will be possible to get nearly all before the lice spread over the foliage generally. It is stated by Riley that the eggs remain over winter on the trunk of the tree. If this is true, it is probable that a thorough spraying of whale-oil soap, 1 pound to 4 gallons of water, or kerosene emulsion, in which the kerosene is about one-fourth of the mixture, would kill nearly all the eggs.

The elm is also attacked by the Fruit-tree Leaf-roller, to some extent.

THE PINE-LEAF SCALE (*Chionaspis pinifoliae* Fitch.)

White elongated scales on leaves of pine and spruce trees are shown in the accompanying illustration. Beneath the scales, in the spring, will be found a mass of purple eggs. Sometimes very abundant, causing the leaves to fall, as many of them have from the twig of silver spruce shown in the figure. (See Fig. 34.)

Remedies—The same as for the Scurvy Bark-Louse of the apple. The best time to make the application is just after the young lice have hatched, which will be about the first of June. By the aid of a hand lens one can easily keep watch of the eggs and learn just when they hatch each year. The exact time will vary with the lateness or earliness of the season.

INSECT ENEMIES OF THE SPRUCE.

The scale mentioned above is quite as common on silver spruce in Colorado as on pine. The remedy, of course, is the same.

There are also two important plant lice attacking the spruce trees, one of which (*Chermes abietis* Linn.) produces brown cone-shaped galls at the tips of the twigs. The adult

females live over winter on the trees and deposit clusters of brownish eggs, all of which are attached to the twig or to each other by means of slender silken threads. The writer has found over 400 eggs in a single cluster. The eggs hatch about the first of June at Fort Collins and the young lice, according to the observations of Mr. R. A. Cooley of the Mass. Agricultural College, go at once to the bases of the young leaflets where they insert their beaks and suck the sap which causes the peculiar growth mentioned above. I have seen the galls on silver spruce, only, in Colorado, and have seen them most abundant near timber line on the mountains.

Remedies—Probably the best remedy is to collect and destroy the galls during the latter half of June and early in July, before the lice escape from them. Where very abundant, it would pay to make an application of kerosene emulsion or whale-oil soap in about double the ordinary strengths during the latter half of May.

What appears to be another species of *Chermes*, lays its eggs in great numbers on the leaves of Douglass spruce during the month of May. The female, while laying the eggs, secretes a quantity of white waxy threads which so surround the egg-clusters that the latter are hardly visible. The eggs hatch at Fort Collins about the 25th of May and the little dark-colored lice locate on the leaves. A twig showing these egg-clusters covered by the waxy secretion of the lice is shown in the accompanying illustration. (See Fig. 35.)

Remedies—I have been completely successful in destroying both eggs and lice by applications of either kerosene emulsion or whale-oil soap in double the ordinary strengths. In the ordinary strengths, the majority of both lice and eggs were killed.

MILKWEED BEETLE. (*Tetraopes femoralis* Lecont.)

Injuring Young Nursery and Forestry Trees.

A plantation of young forestry trees set out on the College grounds by the Department of Agriculture, Division of Forestry, has been badly injured by the above beetle. My attention was first called to the injuries by Professor Crandall who brought me a specimen of the beetle doing the work. The beetle did the damage by cutting transverse gashes in the tender stems and in the petioles of the leaves. A great many gashes were usually cut in each stem, causing them to die or break over. In many of the gashes eggs

were deposited. Fig. 36 shows two of the beetles and stems of locust on which they are working. The drooping leaves were all dead and brown.

Remedies—These beetles seem to have come onto the little trees from a large patch of milkweeds that were close by. If the milkweeds had not been allowed to grow in the vicinity of the forestry plot it is probable that the trees would not have been injured.

INSECTS INJURIOUS TO FARM AND GARDEN CROPS.

THE SQUASH BUG. (*Anasa tristis* De Geer.)

A rather large bug, varying from one-half to three-fourths of an inch in length and varying in color from a grayish brown to a dull black color above and dingy yellow beneath. On account of their strong musky odor they are often called "stink bugs." The bugs begin to accumulate about various vines of the squash family, particularly the vines of the Hubbard and other winter squashes about the time the first true leaves appear. There are two broods, the adults of the second brood living over winter under rubbish.

Remedies—As this insect does its feeding by inserting a sharp beak and sucking the sap of plants, it is evident that it would be useless to apply a poison that has to be eaten to kill. For a considerable number of days before egg-laying

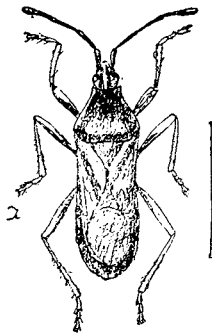


Fig. 37.—Squash bug enlarged. (After Snow.)

the mature bugs gather about the vines to feed and mate. Often they collect on a single leaf causing it to wilt. By visiting the vines each morning the bugs can be rapidly

crushed or collected and destroyed. This is really one of the best methods we have of keeping this insect in subjection. A little later the eggs, which are deposited on the under side of the leaves in loose clusters, can be quite rapidly destroyed by hand collecting. When the young hatch they have the habit of collecting in large numbers on single leaves. They are very shy and will run rapidly away when approached in the warm part of the day, but one can collect them rapidly in the morning about sun-rise. Take a basin or other suitable dish, with a little water in the bottom and a spoonful of kerosene on top, and go to these infested leaves and quickly brush the bugs into the basin. Every one that comes in contact with the oil will die in a very few seconds.

I have been able to kill large numbers of bugs with kerosene emulsion by spraying it forcibly upon them and thoroughly wetting them down, but in most hands the preceding remedies will prove most successful.

THE STRIPED CUCUMBER BEETLE. (*Diabrotica vittata* Fabr.)

A small yellow beetle, about one-sixth of an inch long with a black head and three black longitudinal stripes on the wings when the latter are closed. The beetles appear soon after the cucumber, melon and squash vines are up and eat holes in the leaves until the plants wither and die.

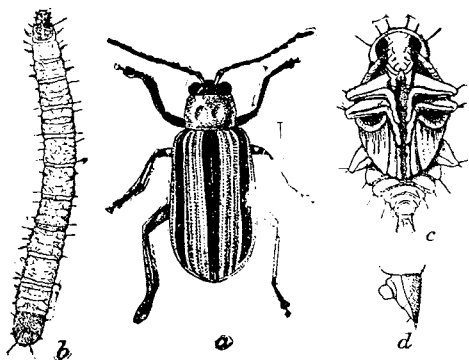


Fig. 38.—Striped Cucumber Beetle: a. mature beetle; b. mature larva; c, pupa; d, side view of last segment of larva. All considerably enlarged. (Chittenden, Circular 31, Second Series, U. S. Dep. of Agr., Div. of Entomology.)

Eggs are also laid about the stems of the plants and the grubs hatching from these burrow down into the roots of the plants which also causes their death.

So far, this insect seems only to occur in this state, along the Arkansas River from Canon City to Rocky Ford.

Remedies—There are many methods of dealing with this pest. One is to plant much more seed than is wanted to grow that enough of the plants may be left after the beetles have had what they want. Planting extra seed is all right, but more should be done. Dusting the leaves freely with lime, plaster or ashes in the evening or early morning, while the dew is on, will usually result in driving the beetles to some other patch, but will not destroy them. A method much practiced consists in covering the plants with mosquito netting until they are large enough to withstand the attack of the beetles. This may be done by tacking the netting over one end of open boxes that are then set about the plants, or by bending a withe over the plants, laying the netting upon it and holding it down by clods of earth.

I have found I can kill these insects very successfully by dusting Pyrethrum or Insect Powder upon them from a cheesecloth sack. To be successful the treatment must be made before sun-rise in the morning. Then, by lightly brushing the leaves, the beetles, damp and sluggish with the dew of the night, will fall to the ground and, if dusted in this condition with the Pyrethrum, will be readily killed.

THE MELON LOUSE. (*Aphis cucumeris* Forbes.)

A greenish louse occurring in great numbers on the underside of the leaves of watermelon, muskmelon, cucumber and squash vines, causing them to curl and turn yellow.

Remedies—It is so difficult to get insecticides upon this louse that there are no satisfactory remedial measures known for it. It is probable that its attacks can be avoided to some extent by a judicious rotation of crops and by plowing under the vines of infested patches as soon as the crop has been gathered.

FLEA-BEETLES.

There are several species of minute flea-beetles usually black in color and not as large as the head of an ordinary pin, which attack various garden plants, principally cabbages, radishes, beets tomatoes and potatoes. The damage is done by eating small holes in the leaves. When approached, the beetles jump and hence the name "flea beetles."

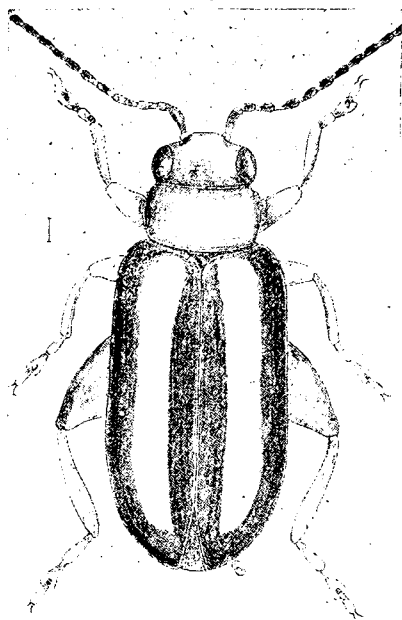


Fig. 39.—Striped Flea-Beetle (*Systema tenebrata*) greatly enlarged.

Remedies—The same as for the Striped Cucumber Beetle.

THE BEAN BEETLE. (*Epilachna corrupta* Muls.)

This is by far the most destructive bean pest in Colorado. The mature insect is a beetle about one-third of an inch in length and yellowish to rusty brown in color with sixteen small black spots on its wing covers. The beetles deposit their yellow eggs in patches on the underside of the bean leaves. The grubs are light yellow in color and are covered with stout branched spines. The insect, in all stages, feeds upon the leaves and green pods of the cultivated beans and particularly wax beans. Lima beans are seldom badly eaten by them. See Fig. 40.

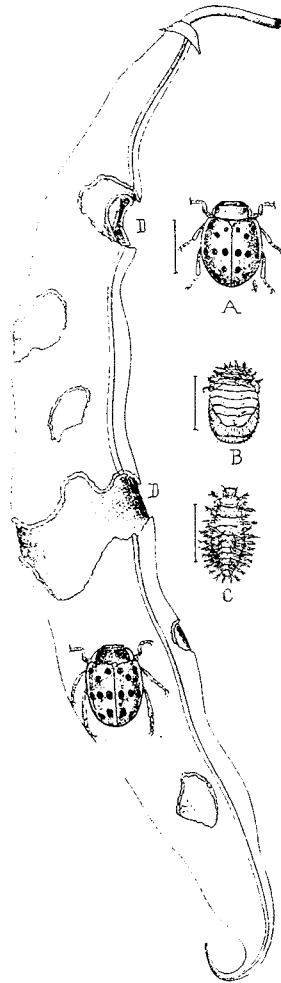


Fig. 40.—A, beetle; B, pupa; C, larva; D, a pod that has been eaten into. All a little enlarged.

Remedies—On account of beans being very susceptible to injury from the application of arsenites, it is rather difficult to treat this insect with satisfactory results. If the arsenites are used, lime should be freely added. I have had best success by using kerosene emulsion of double strength (in which the kerosene is one-eighth of the mixture), spraying it on the underside of the leaves for the destruction of the eggs and newly hatched grubs.

THE PEA WEEVIL. (*Bruchus pisi* Linn.)

This is the insect that causes what are known as "buggy peas," and by most people it is only known in the beetle state, in the spring of the year, when it is found in the peas or the peas are found to have large holes in them made by the weevils. These beetles lay small yellow eggs on the pods of the green peas and the little grubs hatching from them eat through the pod and enter the peas and are often devoured in great numbers by those who eat green peas. If the grubs have entered the peas the fact can be discovered by the presence of very small punctures as if made by the point of a needle.

Remedies—As soon as the green peas have been gathered, pull the vines and destroy them by fire or otherwise.

For the destruction of the beetles in seed peas inclose the seed in a tight receptacle and use carbon bisulphide, about one tablespoonful to a cubic foot of space. Continue the treatment for 24 hours.

THE COLORADO POTATO BEETLE. (*Doryphora 10-lineata* Say.)

This beetle, so common upon potato vines, is too familiar to the farmer to need any description. In this state it is also common upon its native food-plant, the "buffalo bur" (*Solanum rostratum*.)

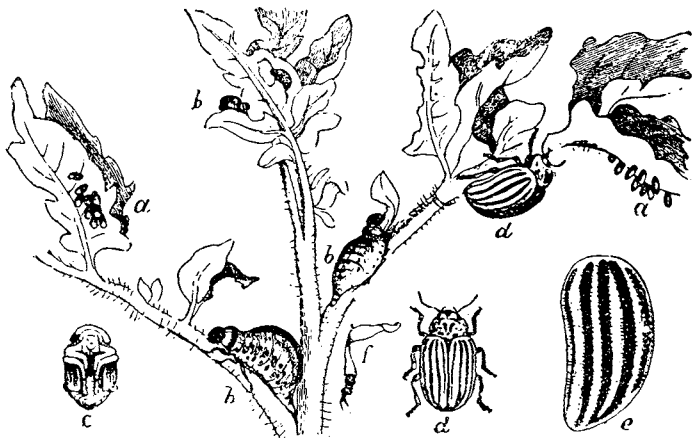


Fig. 41.—Colorado Potato Beetle: a, a, egg patches; b, b, young larvae; c, pupa; d, mature beetle; e, the fore wing much enlarged to show markings.

Remedies—Paris green or London purple dusted or sprayed upon the potato vines are so efficient remedies that no others need be mentioned.

THE ONION THRIPS. (*Thrips striatus* Osb.)

A very small insect, slightly yellowish in color and one twenty-fourth of an inch in length, very active and mature, occurring upon onion tops in enormous numbers, causing them to whiten and wilt down prematurely. The insects

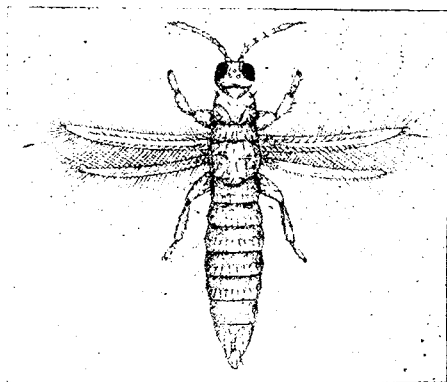


Fig. 42.—Onion Thrips, adult, greatly enlarged.

are so minute that it is often the case that the cause of the dying down of the tops is not discovered by the owner of the crop.

Remedies—At the beginning of the attack thoroughly spray the onions with kerosene emulsion or whale-oil soap of the ordinary strengths.

CABBAGE APHIS. (*Iphis brassicae* Linn.)

A green plant louse on the underside of the leaves of cabbage, cauliflower, turnip and similar plants. The bodies of the lice are covered with a fine whitish powder, often occurring in enormous numbers late in the summer and in the fall.

Remedies—Kerosene emulsion and whale-oil soap are the standard remedies against these as well as other plant lice. It is difficult to make the application effectual, however, on account of the curling of the leaves of the plants that the lice infest and the mealy covering to the lice which causes all liquids to run from their bodies as water runs from a duck's back. To be effectual the application must be made with sufficient force to knock the lice from the leaves, in which case most of the lice will be killed. The lice live

over winter upon cabbages or their stumps that are left in the field in the fall. These should all be plowed deeply under or otherwise destroyed in the fall. An additional precaution of considerable value is to rotate the crop so as not to grow a crop nearer than necessary to ground where the lice were present the preceding year.

THE IMPORTED CABBAGE BUTTERFLY. (*Pieris rapae*
Linn.)

This insect in the mature state is a white butterfly with black tips to the anterior wings and the male usually has four and the female six small black spots on the wings above as shown in the accompanying illustration.

The butterflies appear early in the spring and are ready to begin laying eggs on leaves of cabbages, cauliflowers, turnips and some other Cruciferous plants as soon as the plants are set out. The eggs are light yellow in color and are deposited singly. The worms, soon after hatching, assume a dark green color, almost identical with that of the leaves which serve as their food. Not infrequently the worms eat into the head of cabbages and ruin them for the market.

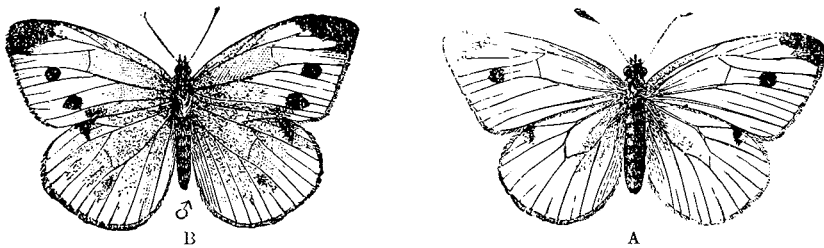


Fig. 43.—Imported Cabbage Butterfly: A, male; B, female. As seen from above, natural size. (After Riley.)

Remedies—Mix one pound of Paris green with twenty pounds of wheat flour and lightly dust the leaves while the dew is on. Apply freely up to the time the heads begin to form and after that use rather sparingly on cabbage heads and not at all on cauliflowers. Do not use nearer than ten days to the time when the cabbages are to be harvested. If used freely when the cabbages are small, there will be little need of much being applied when the heads are nearly grown. If used as above directed there will be no danger from eating the cabbages. Cabbage leaves are all the time opening out so that the leaves that are a part of the head

one day will, a few days later, be standing up free from the head.

For those who object to using poison, I would recommend insect powder (Pyrethrum) which is the best used dry in a small bellows by means of which the powder is driven down among the bases of the leaves to reach all the worms. This substance must be put onto the worms in order to kill them.

If much poison has been used it will not do to turn stock into the patch to eat the leaves and stumps after the crop has been gathered.

THE CABBAGE PLUTELLA. (*Plutella cruciferarum* Zell.)

This insect is a small moth, less than half of an inch in length and with narrow wings that have a white inner margin and when closed make a conspicuous white line along the back as shown in the accompanying figure. The larvæ are correspondingly small and are very active, wriggling

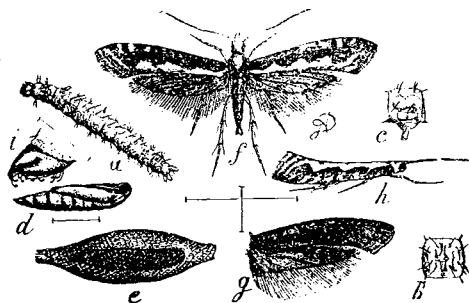


Fig. 44.—The Cabbage Plutella: a, larva; d, chrysalis; e, silken cocoon with chrysalis inside; h, moth with wings closed; f, moth with wings spread. All enlarged about twice. (After Riley.)

themselves quickly off the leaves when disturbed and dropping on a silken thread. When fully grown the larva spins a delicate white cocoon among the leaves. These I have found as early as June 10th at Fort Collins and the moths have appeared in our breeding cages as early as June 16th.

There are two, and perhaps three, broods in a season.

Remedies—The same as for the preceding species. Apply early so as to kill the first brood.

There are three other “worms” that feed upon cabbages to some extent in the state, but I will not give them special mention as the remedies are the same as for the species above mentioned.

CUT-WORMS.

Some dingy colored larvæ that burrow in the ground and have the pernicious habit of cutting off young plants of corn, beans, cabbages, tomatoes, etc., during the night.

There are a large number of species of these worms, each changing, finally, to a particular species of night-flying moth. It is very largely these moths that fly about lights in the evening.

Remedies—These worms are usually worst on newly turned sod. Probably the best field remedy is to plow late in the fall and then, in the spring, keep down all growing

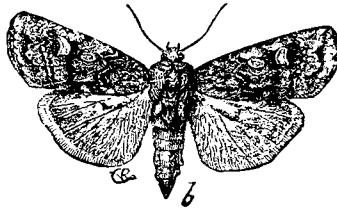


Fig. 45.—Cut-worm Moth. (Biley, Rep. U. S. Dep. of Agr., 1884)

vegetation and scatter over the field a large number of small bunches of green vegetation (alfalfa, grass, cabbage leaves, weeds, etc.,) that has been thoroughly dusted with Paris green or London purple.

In gardens, individual plants of cabbage, tomatoes and the like may be protected by wrapping about them stiff paper or cylinders of scrap tin. The latter may be cut about five inches long by three inches wide and then wrapped around a hoe handle or similar object to give them form. Then separate the sides of the cylinder enough to admit the plant and crowd the tin into the ground enough to hold it firmly. Stiff paper may be used instead of the tin. Do not hoe the garden too clean of weeds while cultivated plants are small as the cut-worms like the weeds as well as anything for food. If the latter are all cut down there is nothing but cultivated plants for them to feed on. This may seem to be questionable advice, but it will work well if the weeds are not neglected too long, so as to choke the other plants.

GRASSHOPPERS.

The loss to crops from the attacks of grasshoppers is annually very large in this state. Even the dry pasture lands in many places support a horde of these greedy ma-

raiders that would be appalling to an eastern agriculturist. No description is necessary to enable my readers to recognize a grasshopper. The species that does by far greatest harm to farm and garden crops in Colorado is the large two-striped grasshopper (*Melanoplus bivittatus*).

This and several closely related species deposit their eggs in little pouches or pockets in the ground in the man-

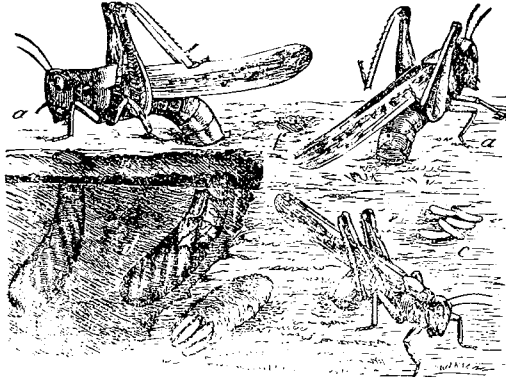


Fig. 46.—Rocky Mountain Locust laying eggs: a, a, females with their abdomens inserted in the ground; b, an egg-pod broken open; c, scattered eggs; d, egg-packet being formed by female; e, egg packet completed. (After Riley.)

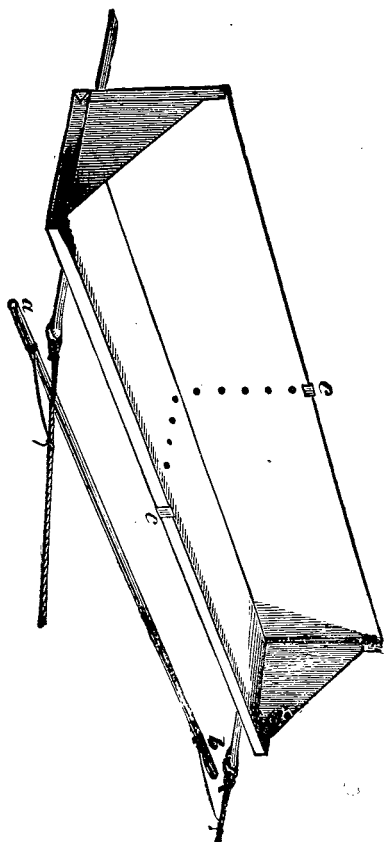


Fig. 47. Hopper pan or "hopperdozer." (After Riley.)

ner shown in Fig. 46. These eggs are mostly deposited about the borders of the fields, along ditch banks and along road sides where the earth is rather firm. They are deposited in the fall and the little hoppers hatch out early the following spring. There is but one brood a year.

Remedies—Where it can be used, the hopper pan or "dozer" is one of the best means of destruction. Fig. 47 will give an idea how these can be made. Make the bottom of the pan eight to twelve feet long, about eighteen inches wide and two inches deep. Have a back to the pan about eighteen inches to two feet high of canvas to prevent the grasshoppers from jumping over. Mount the pan on low runners and draw it over the field with horse power where the grasshoppers are most abundant, first putting in

the pan a strip of cloth reaching the whole length and pouring upon it at least a pint of kerosene. The canvas at the back of the pan should also be kept wet with the oil. This plan of using the hopperdozers is as used by Dr. Lugger who has had a large amount of experience with them in Minnesota. Every grasshopper that comes in contact with these cloths and gets the oil upon any portion of itself will soon die. As the oil evaporates more must be added.

In orchards, vineyards and gardens where the pans cannot be used, poisoned baits made by mixing one pound of Paris green with six to ten pounds of bran, with just water enough to moisten the whole, may be prepared and scattered about in small quantities where the hoppers are thickest. Many will eat the poisoned bran and die. Paris green or London purple may also be sprayed on the food plants of the grasshoppers where it is safe to use it. Care must also be exercised in the use of poisoned bran that chickens and other domestic animals may not be poisoned.

THE MEDITERRANEAN FLOUR-MOTH. (*Ephestia kuhniella* Zell.)

This insect has attracted attention in this country and in Europe almost exclusively as a pest in flouring-mills. My attention was first called to the insect in Colorado on September 14th, 1893, when I received some honey comb from Mr. R. C. Aikin of Loveland, which was very badly infested with the larvæ and webs of this insect. The moths were also appearing at the time. The moth is gray in color with narrow wings and spans about three-fourths of an inch and is very well represented, at Fig. 48. Fig. 49 shows the appearance of the webs on a frame of honey comb.

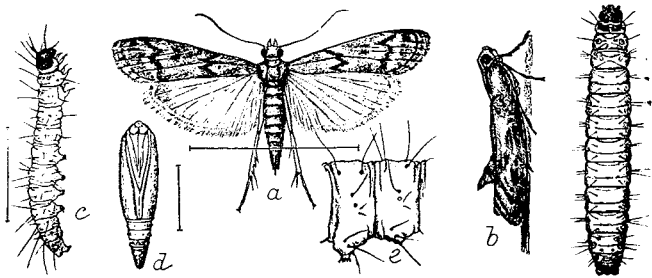


Fig. 48.—Mediterranean Flour-Moth: a, moth with wings spread; b, moth with wings closed; c, larva; d, chrysalis; e, two segments of the larva greatly enlarged. All somewhat enlarged. (Riley & Howard, Insect Life, Vol. II, U. S. Dep. of Agr., Div. of Entomology.)

The larvæ seem not to feed upon the honey or wax but upon the old pollen left in the cells, though they will often gnaw through the thin walls of the cells to get from one into another. This insect does not trouble the combs in hives occupied by bees but only combs that have pollen and are stored away for future use.

Remedy—Inclose the infested combs in a tight box with carbon bisulphide. Use a teaspoonful of the liquid to each cubic foot of space in the box.

To destroy the worms in mills, use about one quart to each 1,000 cu. ft. of space. Always be careful not to bring fire in contact with the fumes as they are explosive when mixed with air.

ANTS.

Ants often become troublesome in the pantry, the lawn or the apiary and many inquiries are received as to how they may be destroyed. Where the hill can be found, thrust a stake into it to the depth of about a foot, pour in two or three ounces of carbon bisulphide, stamp the hole full of dirt, and then throw a damp blanket over the hill to hold down the fumes. The fumes of the carbon bisulphide are explosive when mixed with air, so care must be used not to bring fire in contact with this substance unless for the purpose of exploding the fumes in the ant hill.

If the ants are troubling in the house, thoroughly dust the ants and their run-ways with insect powder (Pyrethrum.)

THE BED BUG. (*Cimex lectularia* Linn.)

I take it for granted that this unwelcome guest of some of the homes of this country is not familiar to all my readers and so briefly describe it as a light yellow to dark brown bug, without wings, about one-fourth of an inch in length when fully grown, and very flat. The color and shape together has suggested to someone the very polite name "mahogany flat." Like other evil-doers, it avoids the light and is often unseen and not suspected in sleeping apartments where it is present in large numbers. Its hiding places are usually in cracks of the bedstead, under the binding of mattresses, under wall-paper and similar places of concealment. In these places the eggs (nits) which are elongate white objects, of very small size, are deposited, sometimes in great numbers.

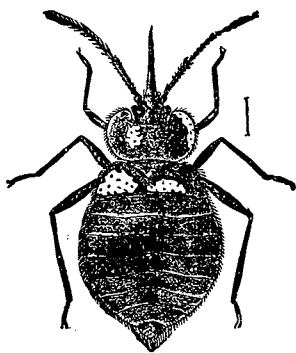


Fig. 50.—Bed Bug, much enlarged. (Osborn, Bull. 5, New Series, U. S. Dep. of Agr., Div. of Entomology.)

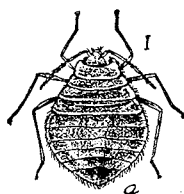


Fig. 51.—Bed Bug, young. (Osborn, Bull. 5, New Series, U. S. Dep. of Agr., Div. of Entomology.)

Remedies—Use bedsteads that will offer as few places as possible for the bugs to hide in. Have no loose paper on the walls under which the bugs can crawl. Put bedding and carpets and every other infested article, so far as possible, in boiling water. Pour boiling water into all places that can furnish concealment for the bugs so far as possible. By means of an atomizer or a small brush or feather apply gasoline, benzine or turpentine to cracks and crevices where the bugs or their eggs might be concealed. If these means have not been sufficient, fumigate the house with sulphur or with carbon bisulphide. Candles for the purpose of fumigating houses can be obtained at almost any drug store.

It will not do to make one treatment of any kind and then think no more is to be done. Make several careful searches a few days apart and continue the warfare 'till no more vermin are found.

CLOTHES MOTHS.

There are few insects that give housekeepers more annoyance than the clothes moths. There are but two species that give much annoyance in houses in this country and they are of a yellowish or buff color, with narrow wings and slender bodies, and when spread will span but little more than half an inch from tip to tip of the wings. They are often seen as very small moths flying about the room after lamps are lighted. The large moths that often fly to lights in our houses and flutter about on our windows, are frequently supposed to be clothes moths, but they are not.

The clothes moths feed upon animal tissue as hair, feathers and wool, but do not attack cotton or linen goods.

Remedies—The frequent airing and beating of garments and carpets is one of the most effectual remedies. When clothing is laid away for the summer it may be put in tight paper sacks or in pasteboard boxes made tight by wrapping, or in any other moth-tight receptacle where the moths or their eggs are not already present. To make sure that no eggs were deposited on the clothing before it is put away, it should be examined once or twice to see that it is all right. The lighter the room where the clothing is stored the better, as clothes moths delight to work in dark rooms and closets, but seldom do much harm in rooms that are well lighted and aired. If clothing is thought to be infested, all moths, eggs and larvæ can be killed by placing the clothing in a tight box and pouring in carbon bisulphide and then closing tightly for a few hours. If the moths in any stage are about the borders of the carpet, they may be destroyed by spreading damp clothes over the infested places and then ironing them with hot flats.

Moth balls, camphor, tobacco and cedar wood are used to repel the moths and are quite useful for this purpose, but if the insects are already present these things do not prevent their living and doing their usual injuries.

THE CARPET BEETLE. (*Anthrenus scrophulariæ* Linn.)

A small, dark-colored beetle, about three-sixteenths of an inch long and marked on the wing covers with white and a slight amount of reddish. The larva is dark brown in color and is rather heavily fringed with hairs, especially at

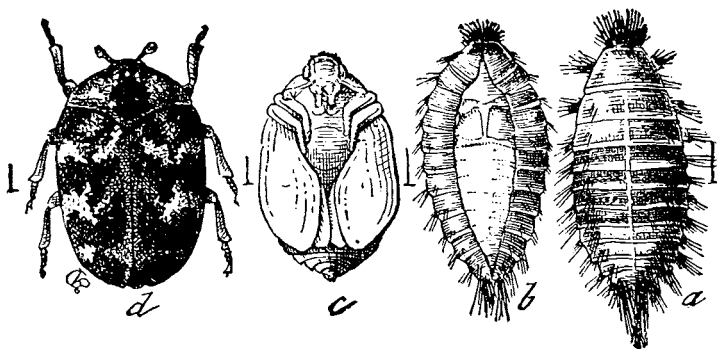


Fig. 52.—Carpet Beetle or Buffalo Moth: a, larva; b, pupa within the larval skin; c, pupa removed from larval skin; d, adult beetle. All greatly enlarged. (After Riley)

the tail end end of the body. It works most about the borders of carpets and along cracks in the floor. It is most commonly known as the "Buffalo Moth," but it is not a moth at all but a beetle.

Remedies—This household pest is more difficult to rout than the clothes moths above mentioned. The treatment is the same but needs to be more vigorously and persistently applied. If very troublesome it will be found best to do away with carpets and use rugs instead, the rugs to be frequently removed from the house and beaten.

INSECTICIDES.

An insecticide may be defined as any preparation which can be used for the destruction of insects. Insects are animals and the substances that will kill animals of large growth will, as a rule, kill insects also.

In order to apply insecticides intelligently one should know the principle underlying their use, then he does not have to be bound by any fast rule. These principles are so simple that I will give them.

We may separate the insect-destroying substances into

THREE CLASSES,

depending upon the manner in which the death-dealing work is done.

First, and most important among these, are the food-

poisons, or those substances which kill by being eaten. It must be evident to all that these can only do harm to insects that devour the tissue of the plant, nearly always the leaves. Those insects that feed by inserting a sharp beak and sucking the sap of the plant can not be successfully combatted by the use of food poisons. Against them we must, as a rule, use some substance that will kill by external contact. There are, of course, a great number of preparations that would kill in this way but we have to use something that will destroy the insect without serious injury to the plant on which it is feeding.

It is not necessary that one be versed in the science of entomology in order to be able to determine into which of these two classes an insect that is doing damage to his plants belongs. If the foliage of the plant is being removed, or if the leaves are full of holes or ragged as the result of the insect attack, it is reasonably certain that the marauder has a good pair of jaws and is devouring the solid parts of the leaves; but, if the leaves only turn pale or brown and curl, and are not eaten into, it is then quite certain that the insect is doing the damage by extracting the juices of the plant. Examples of such insects are Plant Lice, Scale Lice, the Squash Bug, Chinch Bug, etc. Examples of the former class are Grasshoppers, Potato Beetles, Leaf Rollers, the Codling Moth, etc.

Then there are insects in both of the above classes that are best destroyed by the use of certain volatile substances which kill by being inhaled. As examples I might mention certain grain-eating weevils, ants, root-infesting lice, vermin in houses as Bed Bugs, and Clothes Moths, etc.

In its broadest sense the term insecticide is also made to include certain substances which are used only as repellants. These do not kill and are of much less value than either of the other classes. Naphthaline, camphor and carbolic acid are examples of such substances.

PREPARATION AND USE.

It will be understood that almost any insecticide may need to be used in different strengths under varying conditions. In the following formulæ I give the ordinary preparations.

FOOD POISONS.

PARIS GREEN ; WATERY MIXTURE.

Paris green,..... 1 pound.
Lime (unslaked,)..... 1 pound
Water,..... 160 gallons.

First thoroughly mix the poison in a small quantity of water and then add the remainder of the water. Slake the lime in a small amount of water and add to the mixture. If the lime is lumpy after slaking, strain it to avoid clogging the spraying nozzle.

PARIS GREEN ; DRY MIXTURE.

Paris green..... 1 pound.
Wheat flour,..... 20 pounds.

Apply, if possible, when the foliage is moist with dew and when there is no wind. If the plants are low, the mixture may be easily applied by inclosing it in a muslin sack which is shaken over the foliage.

Plaster, or lime may be used as a dilutent in place of the flour but the flour is considered best as it sticks the poison to the leaves causing it to remain longer.

LONDON PURPLE.

Prepared in the same ways as Paris green. It is somewhat cheaper than that poison but it is not considered quite as effective in destroying insects.

KEDZIE'S ARSENITE OF LIME.

Dr. R. C. Kedzie, chemist of the Michigan Agricultural College and Experiment Station, has given directions for making arsenite of lime and some who have used it prefer it to either Paris green or London purple. When prepared it is the same as the latter substance except the small amount of coloring matter which is accidental and serves in the London purple to distinguish it from substances that might be mistaken for food. Dr. Kedzie's directions are as follows :

"Boil two pounds of white arsenic and eight pounds of salsoda for fifteen minutes in two gallons of water. Put into a jug, label '*poison*' and lock it up. When ready to

spray, slake two pounds of lime and stir it into forty gallons of water, adding a pint of the mixture from the jug."

As white arsenic, salsoda and lime are all cheap substances, this is a very economical mixture. It may be used as a substitute for either of the preceding.

ARSENIC-BRAN MASH.

This preparation has been used almost exclusively for the destruction of grasshoppers in places where hopper-doers can not be used. Prepare by taking

White arsenic (or Paris green) 1 pound.
Wheat bran 10 pounds.
Water enough to make moist.

☐ Scatter in small quantities in places where they will be most likely to find it.

Care must be used not to place the bran where it will be devoured by domestic animals.

BORDEAUX MIXTURE AND THE ARSENITES.

Bordeaux mixture is a fungicide and is the substance most often used for the destruction of fungi that attack the the surface of plants. It has also been found to be of value for use against flea-beetles and the writer also demonstrated its value a number of years ago as a medium in which to spray Paris green or London purple. These poisons can be used very strong in this mixture without injury to foliage and they do not, in the least, lessen its effects as a fungicide. Such a mixture would destroy both insects and fungi with one application.

The Bordeaux mixture may be prepared as follows: Take of

Copper sulphate 6 pounds.
Quicklime 4 pounds.
Water 45 gallons.

Dissolve the copper sulphate in a gallon of hot water, slake the lime in another gallon of water and then add the milk of lime slowly to the copper sulphate solution while the latter is being constantly stirred. Then add 43 gallons of water.

If insects are to be killed at the same time, add to the above quantity of Bordeaux mixture, one-third pound of London purple or Paris green.

HELLEBORE.

Powdered white hellebore has been found particularly useful for the destruction of certain insects and may be applied dry or in water. If applied dry it may be used pure or diluted a few times with flour. I prefer to use the powder pure when the slightest dusting over the leaves in the evening when the dew is on is usually effectual. Inclose the powder in a cheesecloth sack and shake it over the plants.

If applied in water use

Hellebore	1 ounce.
Water	3 gallons.

EXTERNAL IRRITANTS.

It should be borne in mind that, in order to destroy an insect by an external irritant, the substance must be put upon the insect's body. Spraying the food will not answer.

KEROSENE EMULSION.

This preparation has no equal for the destruction of insects by external contact, so far as we know at present. The substances of which it is composed are always obtainable and the emulsion is not difficult to make after one has learned how. For the ordinary strength the proportion of the ingredients is as follows:

Soap	1 pound.
Kerosene	2 gallons.
Water	28 gallons.

Prepare by dissolving the soap in a gallon of water; while the soapy water is boiling hot, remove from the fire and immediately add two gallons of kerosene and agitate briskly for a few minutes. If a large amount is being made, use a force pump and forcibly pump the mixture back into the receptacle that contains it until all is a frothy creamy mass. If such a mixture is not obtained the first time, put the whole back over the fire until boiling hot and then repeat the pumping and the emulsion will almost surely form. If put back for reheating watch very closely to see that it does not boil over and take fire.

After the emulsion is made add the remaining 27 gallons of water and all is ready for use.

When small quantities are made, emulsify with an ordinary egg-beater.

To be sure of success, use clean dishes and clean water.

WHALE-OIL SOAP.

This substance stands close to kerosene emulsion in importance as a destroyer of soft bodied insects. It is used in various strengths, but the ordinary preparation is:

Whale-oil soap.....	1 pound.
Water.....	8 gallons.

As a winter wash, it is sometimes used as strong as two pounds in a gallon of water for the destruction of San Jose and other scales. A pound to eight gallons destroys the eggs of plant lice or of the Brown Mite.

TOBACCO.

Tobacco has long been used in one way or another for the destruction of insects. Its chief use seems to be for the destruction of animal and plant lice. When slowly burnt, the smoke may be utilized for the destruction of lice on plants in green-houses or window gardens. In the form of a fine dust it is often effectual in ridding plants of flea-beetles and in the form of dust or stems is probably the best remedy we have for Woolly Aphis on the roots of apple trees.

I have a letter from the A. B. Mayer Manufacturing Co., of St. Louis, Mo., offering tobacco dust at \$20.00 a ton f. o. b. cars in that city.

PYRETHRUM (Buhach, Persian Insect Powder.)

This substance, under one of the above names, can be obtained at almost any drug store. It consists of the dried flowers of two species of plants of the genus Pyrethrum which are ground into a very fine powder. The powder has the peculiar property of killing almost any insect that it comes in contact with while it is not poisonous to other animals. If applied in water use

Pyrethrum.....	1 oz.
Water.....	3 gallons.

In most cases I prefer to use this substance dry and un-

diluted and it may be distributed by means of blowers made for the purpose or by inclosing in a cheesecloth sack and shaking it over infested plants.

Its chief uses are for the destruction of plant lice, cabbage worms, flea-beetles, squash-beetles, ants, cockroaches and house flies.

LIME, SULPHUR AND SALT WASH.

The following preparation is a favorite one on the western coast for the destruction of scale insects and the Brown Mite. For the latter insect it is reported to be entirely successful about Grand Junction in this state. The following formula and method of preparation I quote from Circular 3, Second Series, Division of Entomology, Washington, D. C. The paper is by Dr. L. O. Howard:

Unslaked lime.....	10 pounds.
Sulphur.....	5 pounds.
Stock salt	4 pounds.
Water to make.....	15 gallons.

This wash will do great damage to the trees if applied during the growing season, and should be used only in winter. All the sulphur and half of the lime are placed in a kettle and $8\frac{1}{4}$ gallons of water added, after which the contents of the kettle are boiled briskly for about an hour. The solution, which at first is yellow from sulphur, will turn very dark brown, assuming more or less of a reddish tint, and will finally change from a thick batter to a thoroughly liquid condition, the product being ordinary sulphide of lime. All the sulphur is added to the remaining five pounds of lime and the latter slaked, after which the slaked lime and salt are added to the sulphide of lime already obtained, the whole being then diluted with water to make 15 gallons. This should be strained before application, as it does not form a perfect liquid solution."

INSECTICIDES THAT KILL OR REPEL BY BEING INHALED.

CARBON BISULPHIDE.

This is an extremely volatile liquid having a very disagreeable odor and its use must be attended with a good deal of caution as it is explosive when mixed with air and brought in contact with fire. It can be used to destroy any insect that can be got into a tight receptacle as a box, jar or room. It is also destructive to root-infesting insects and ants in hills when injected into the ground in proximity to the insects. When employed for the destruction of insects in tight receptacles, use about one quart to every 1,000 cubic feet of space and continue the treatment for 24 hours at least. If used in a building that is not very tight a somewhat larger amount might be required. For fumigating large rooms it is better to place dishes containing the liquid in the upper part of the room as the fumes are heavier than air and settle.

HYDROCYANIC ACID GAS.

This is a very successful remedy against scale insects in California and is used in the following proportions :

Cyanide of potassium, 60 per cent., 1 ounce.
Commercial sulphuric acid, 1 ounce, (fluid).
Water 3 ounces.
Space inclosed, 150 cubic feet.

The fumes given off are extremely poisonous and care must be taken not to inhale them. The tree to be treated is first inclosed in a tent or box, the water and sulphuric acid poured into a dish and set in, and then the cyanide added and the tent or box quickly closed and kept so for about one-half hour.

Figure 12.

Apple Plant Louse: Twig showing eggs. (From photograph by the author.)

Figure 29—A.

A twig of soft maple showing the cottony scales covering it along one side, the under side of the limb. (From photograph by author.)

Figure 29—B.

Cottony Maple Scale: Female scales on leaf and twig with the cottony secretion protruding. (Riley, U. S. Dep. of Agr., Rep. 1884.)

Figure 31.

Trunk of cottonwood tree showing the dark patches on the bark caused by the souring sap from the burrows of the Cottonwood Borer. (From photograph by the author.)

Figure 32.

Elm Leaf-cluster (*Schizoneura americana*): a, b, c, d, successive stages in the early development of the gall; e, the louse covered with cottony secretion at the base of the bud which is just beginning to curl. All natural size. (From photograph by the author.)

Figure 33.

Elm Leaf-cluster (*Schizoneura americana*): a, a, etc., a number of the clusters on an elm limb. Very much reduced. (From photograph by author.)

Figure 34.

Pine-leaf Scale (*Chionaspis pinifoliae* Fitch): A, the scales on leaves of silver spruce; B, scales on leaves of pine. (From photograph by the author.)

Figure 35.

Egg patches of plant louse (*Chermes* sp.) on Douglass Spruce. Each patch of eggs covered by a cottony secretion from the adult louse. Somewhat reduced. (From photograph by the author.)

Figure 36.

Injuries to small locusts trees by *Tetraoesp femoratus*: a, a, etc., gashes cut in the stems by the jaws of the beetle; b, b, beetles at work. (From photograph by the author.)

Figure 49.

A frame of honeycomb showing the cocoons and webs of the worms that were feeding on old pollen. (From photograph by the author.)



Fig. 12.

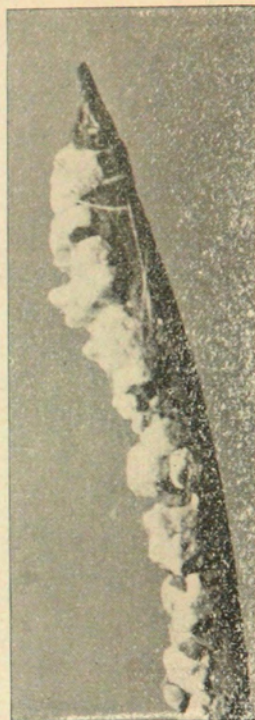


Fig. 29 B.



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Fig. 29 B.

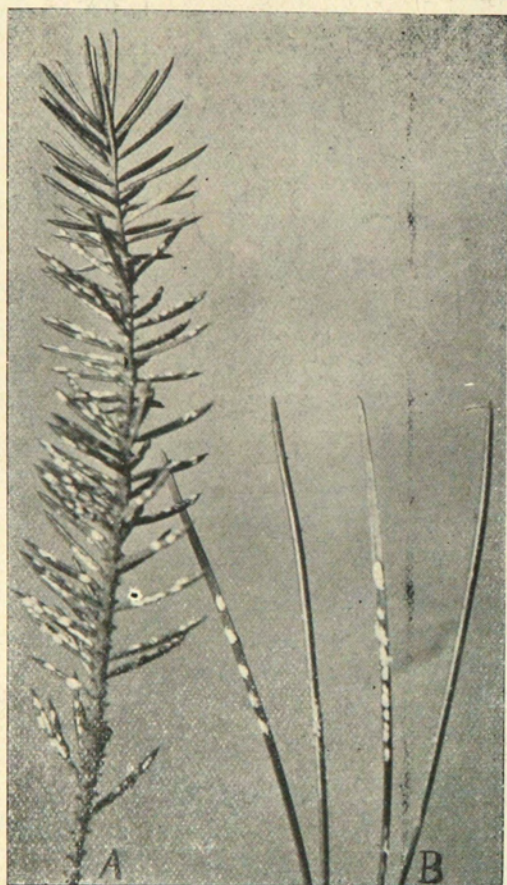


Fig. 34.



Fig. 31.



Fig. 32.

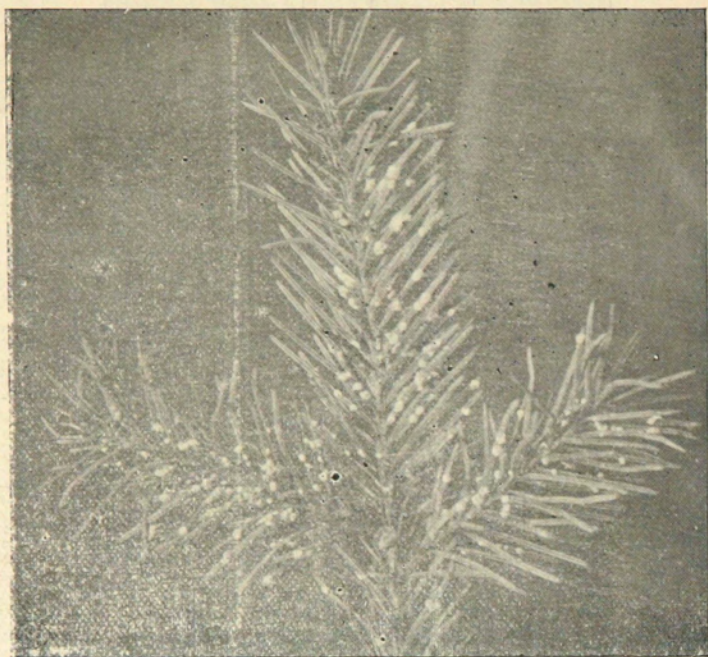


Fig. 35.

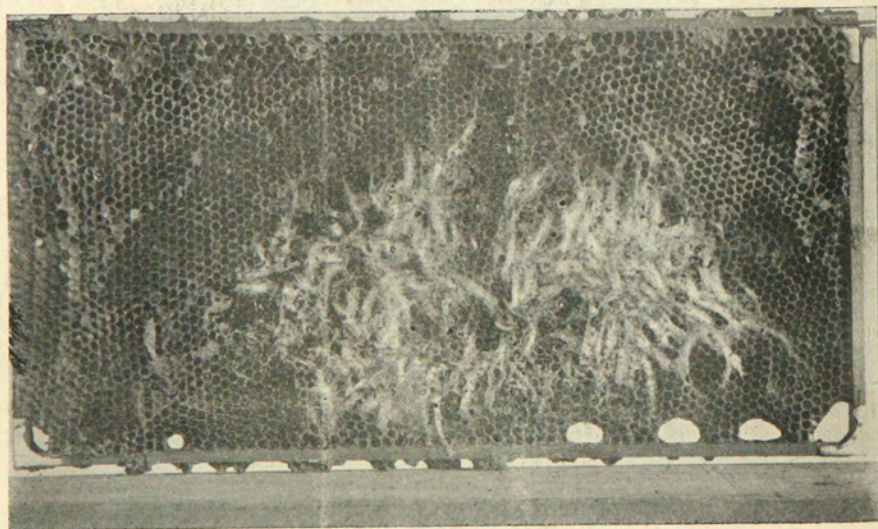


Fig. 49.



Fig. 33.



Fig. 36.